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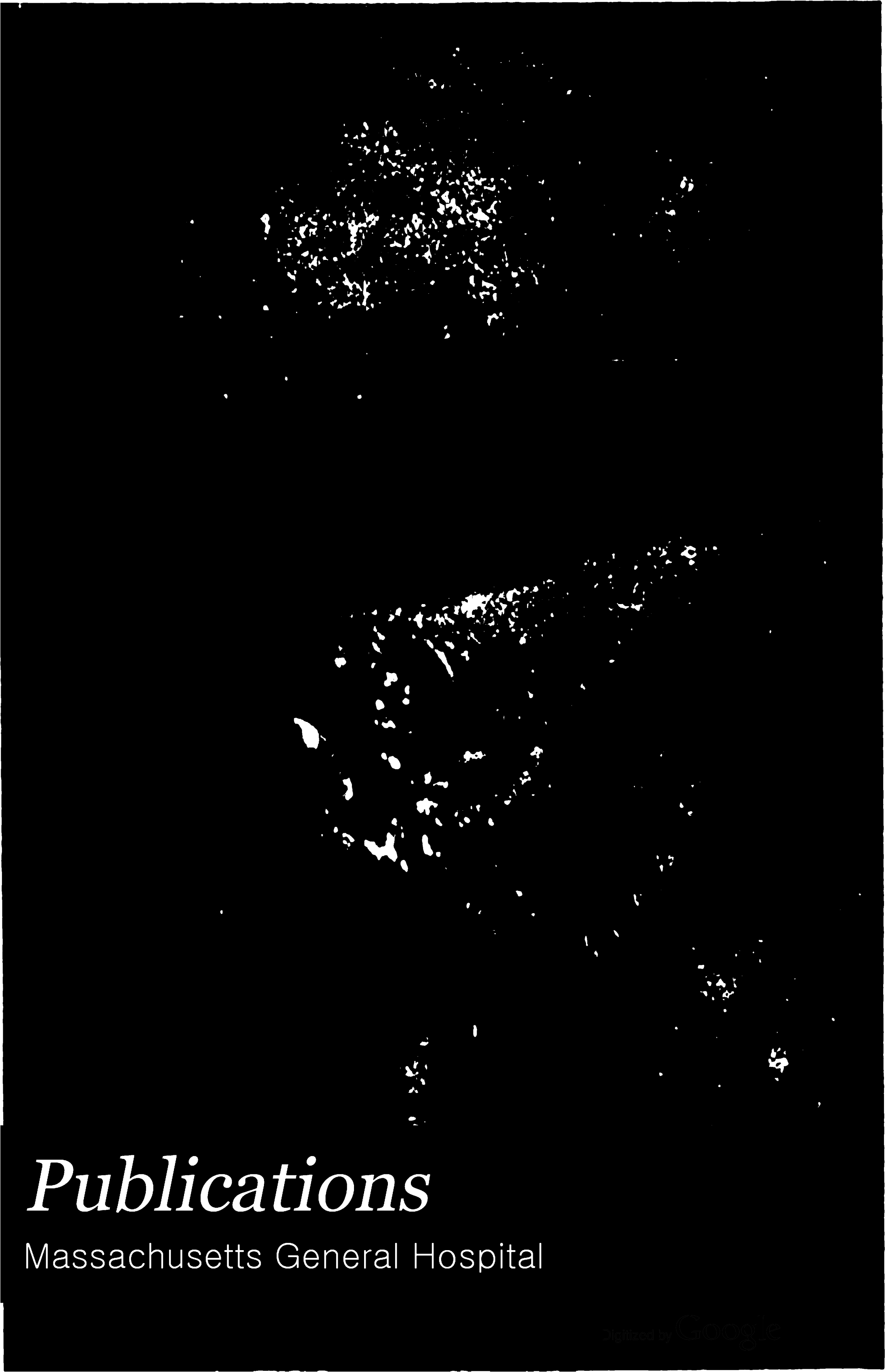

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THE BIOLOGY OF THE MICROÖRGANISM OF ACTINOMYCOSIS

JAMES HOMER WRIGHT, M. D.
DIRECTOR OF THE CLINICO-PATHOLOGICAL LABORATORY.

THE GROSS PRIZE ESSAY FOR 1905

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THE BIOLOGY OF THE MICROÖRGANISM OF ACTINOMYCOSIS.

JAMES HOMER WRIGHT, M.D.

(*Director of the Clinico-Pathological Laboratory of the Massachusetts General Hospital. Instructor in Pathology, Harvard Medical School.*)

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An examination of the published reports of the many workers who have studied the biological characters of the microörganism of actinomycosis shows much that is contradictory and confusing. The reports vary widely in the extent and value of the observations recorded. Much erroneous work has been published, and has been subjected to but little intelligent criticism.

Some writers believe that the disease is due to infection with two or more distinct species of microörganisms, while others belittle or ignore the significance of observations inconsistent with the view that a single species is concerned. The confusion and uncertainty about this subject have been increased by a tendency among writers to class with actinomycosis certain other suppurative processes which have been called pseudo-tuberculosis or streptothrix or cladothrix infections, and which may be sharply differentiated from typical actinomycosis by the absence of the characteristic granules from the lesions.

In my opinion the term actinomycosis should be restricted in its meaning to a suppurative process combined with granulation tissue formation, the pus of which contains the characteristic granules or " drusen " composed of dense aggregates of branched filamentous microörganisms and of their transformation or degeneration products. In the term transformation products are included the characteristic refringent club-shaped bodies radially disposed at the periphery of the granule, for these bodies have long since been clearly shown to arise by a transformation of the peripheral filaments. They may or may not be present at the periphery of the granule. This definition excludes those cases of so-called pseudo-tuberculosis or streptothrix or cladothrix infection referred to, for in none of the reported cases does the infecting microörganism occur in compact and characteristic aggregations as in actinomycosis.

I believe that actinomycosis as above defined should be sharply distinguished from these cases, because, as I hope to show in this paper, the microörganism of actinomycosis differs profoundly in its biological characters from the microörganisms associated with it. In this paper the term actinomycosis will be used in the restricted sense above indicated.

For some years I have devoted considerable time and attention to the cultivation of the microörganism of actinomycosis and to the study of its biological characters. In the present paper I report the results of my observations, together with a review of the literature of the subject.

THE CASES OF ACTINOMYCOSIS WITH WHICH CULTURE EXPERIMENTS WERE MADE AND THE METHODS OF ISOLATION EMPLOYED.

Microörganisms agreeing with one another in all important cultural characters and regarded as belonging to a single species have been isolated and more or less extensively studied in pure culture from thirteen (13) cases of actinomycosis in man and from two (2) cases in cattle. One of these cases has been studied under my direction by Mr. R. I. Lee.

In addition to these, cultures have been obtained both by myself and by Dr. Oscar Richardson from several other human cases, but these were insufficiently studied and the data concerning them are meagre. The growths were observed chiefly in bouillon, and in only one or two instances were agar cultures also made. The cultural features thus observed gave no reason to doubt that the microörganisms from these were of the same species as from the preceding cases.

Culture experiments have been made from a number of other cases, both human and bovine, but the cultivation of the microörganism has not been successful, owing to the development of contaminations with other bacteria in the cultures and to imperfect culture technique.

The cultivation of the microörganism of actinomycosis presents special difficulties, owing chiefly to the frequent presence of other bacteria in the lesions, apparently often intimately associated with the substance of the granules.

Only a small minority of the cases worked with seemed to be essentially pure infections with the specific microörganism. The accompanying bacteria were of various kinds and mostly of unidentified species. These bacteria usually grew more rapidly and more luxuriantly than did the specific microörganism. In some instances they were so numerous that they gave rise to more colonies in sugar agar suspension cultures than did the fragments of the specific granules after they had been thoroughly broken up. This was obviously due to the fact that the bacteria were more readily dissociated from one another and disseminated throughout the medium than were the very coherent masses of the specific microörganism.

Another difficulty in the isolation of the organism was due to the peculiar fact that the colonies in sugar agar suspension cultures often would not grow when transplanted. This seemed to be especially true of the smaller colonies, many of which seemed to die after a very few days. Inasmuch as in badly mixed cultures the smaller colonies were surest to be free from contamination with other bacteria, it was most desirable to transplant them to attain pure cultures. It has thus been necessary in some instances to transplant a number of these small colonies before a pure culture was obtained.

From these statements it will be clear to any bacteriologist that the task of isolating the microörganism of actinomycosis in pure culture from a case in which it is accompanied by other bacteria may be most difficult. On the other hand, if there are few or no contaminating bacteria, or the contaminating bacteria are such as do not grow on ordinary culture media, a pure culture of the microörganism is easily obtained.

The methods of isolation employed have been essentially as follows:

In a few cases pure cultures have been obtained by planting the granules in bouillon, usually after a washing in sterile bouillon, the microörganism composing the granule readily multiplying in the course of a few days in the incubator. With the granules obtained from other cases, however, this mode of isolation was unsuccessful on account of the development of other bacteria.

In a few instances, although contaminating bacteria were present, yet either by successive transplantations to fresh bouillon or by allowing the tube to remain for some days at room temperature, these bacteria died out and transplants then yielded pure cultures.

Generally sugar agar was the medium employed for the isolation of the microörganism. The granules after being washed in sterile bouillon were broken up on the side of the test-tube with the platinum wire or crushed between "slides." The fragments were then distributed throughout melted one per cent dextrose agar that had been cooled to about 40° C., and that was contained in a test-tube filled to a depth suitable for the cultivation of anaërobic bacteria. The tube was then placed in the incubator, and in the course of a few days the characteristic colonies to be described below were sought for and sub-cultures made from them. With the microörganism from one case cultures were thus obtained from the material placed in bouillon which had failed to grow. In another, an anaërobic sugar agar plate culture was used with success to obtain a pure culture of the microörganism from a contaminated bouillon culture.

In some cases the great number of other bacteria developing in the sugar agar tubes has prevented all efforts to obtain a pure culture. In two, pure cultures were obtained in sugar agar suspensions after allowing the granules to dry on the side of a sterile test-tube for eighteen and twenty-two days respectively.

With one of these, attempts to obtain pure cultures without having dried the granules were unsuccessful owing to the excessive development of other bacteria in the agar. The drying, however, seemed to have greatly diminished the number of these other bacteria, and a pure culture was obtained without much difficulty.

As the result of my experience I would recommend the following procedure for the isolation of the microörganism of actinomycosis. The granules, preferably obtained from closed lesions, are first thoroughly washed in sterile water or bouillon and then crushed and disintegrated between two sterile glass slides. If one is working with a bovine case, it is well to examine microscopically the disintegrated material after mixing it with a drop or two of bouillon under a cover-glass to see if filamentous masses are present. If they are not, or if they are very few, proceed no further, but begin again with another granule, because the granules in bovine lesions sometimes contain no living filaments at all, but may be composed entirely of degenerate structures from which no growth of the microörganism can be expected. If filaments and filamentous masses are thus found to be present in the granule, then the disintegrated products of the granule are to be transferred by means of the platinum loop to melted one per cent dextrose agar contained in test-tubes filled to a depth of about seven or eight centimeters which have been cooled to about 40° C. The material is thoroughly distributed throughout the melted agar by means of the loop, and the tube then placed in the incubator. Several tubes should thus be prepared. At the same time a number of granules, after thorough washing in sterile water or bouillon, should be placed on the sides of sterile test-tubes plugged with cotton and kept at room temperature in the dark.

The sugar agar tubes inoculated as above described should be examined from day to day for the presence of the characteristic colonies in the depths of the agar. If very many colonies of contaminating bacteria have developed in the tubes, it will probably be very difficult or impossible to isolate the specific microörganism. If there are a few or no contaminating colonies, then the colonies of the specific microörganism should be expected to develop in the course of two or three days to a week. If a good number of living filaments of the microörganism have been distributed throughout the agar, the specific colonies that develop will be very numerous in the depths of the agar, especially throughout a shallow zone situated about five to twelve millimeters below the surface of the agar agar.

When the presence of the characteristic colonies has been determined, slices or pieces of the agar containing colonies are to be cut out of the tube by means of a stiff platinum wire with a flattened and bent extremity. A piece of the agar is to be placed on a clean slide and covered with a clean cover-glass. It is to be examined under a low power of the microscope, and an isolated colony selected for transplantation. By obvious manipulations, under continuous control of microscopic observation, the selected colony together with a small amount of the surrounding agar agar is to be cut out, care being taken to be sure that no other colony is present in the small piece of agar agar containing the colony. The small piece of agar thus cut out should not have a greatest dimension of more than two millimeters. The piece of agar is then transferred from the slide by means of a platinum loop to a tube of sterile bouillon, where it is thoroughly shaken up in order to free it from any adherent bacteria. If there be reason to believe that the small piece of agar has been very much contaminated with bacteria it should be washed in a second tube of bouillon, then the piece of agar is to be transferred by means of the platinum loop to a tube of melted sugar agar cooled to 40° C. It should be immersed deeply in the agar and the tube placed in the incubator. If the colony thus transferred to the agar agar is capable of growth, in the course of some days it will have formed a good-sized colony from which transplants in various culture media may be made.

In the manner described several small pieces of agar containing single isolated colonies should be placed in sugar agar tubes, because the chances are, as already stated, that some of the colonies will not grow, and contaminations with other bacteria may occur.

If the number of contaminating colonies is so great in the original agar cultures from the granules that it is found impossible or very difficult to obtain specific colonies free from other microörganisms, then it is probably not worth while to expend much labor with the task of isolation from these original agar tubes, but it is much better to wait until the granules placed on the sides of sterile test-tubes have dried thereon for two or three weeks and then proceed with these granules as just described for the fresh granules. The drying of the granules for this length of time will probably suffice to kill off most of the contaminating bacteria and enable isolated colonies of the specific microörganism to be obtained in the agar suspension cultures.

The cases from which pure cultures of the microörganism described below have been obtained are as follows:

Case I. — *Autopsy No.* 470. (Service of Dr. C. L. Scudder.)

Anatomical Diagnosis:

Disseminated actinomycosis.

Actinomycosis of the eighth and ninth thoracic vertebræ.

Extensive purulent infiltration of the para-vertebral tissues in the thorax, with extensive sinus formation and purulent infiltration in the wall of the right side of the thorax where there are operation wounds.

Perforation of the diaphragm on the left side and formation of a subphrenic abscess in the region of the spleen with involvement of the left kidney in abscess.

Purulent infiltration of the para-vertebral tissues in the lower thoracic and lumbar regions.

Abscesses in the lungs, liver, spleen, kidneys, omentum, anterior abdominal wall, left buttock, and right leg.

Evacuated abscess in the right thigh.

Ulcer with suppuration of the underlying tissues in the region of the right trochanter and on the right foot.

Tumor-like abscess in the wall of the right ventricle.

Sub-acute glomerulo-nephritis.

The microörganism occurred in the lesions chiefly in the form of compact filamentous colonies. Only one or two of the colonies showed the characteristic clubs at the periphery.

Stab cultures in sugar agar from the pus of abscesses situated in the liver, lung, abdominal wall, and right foot all yielded a pure growth of the specific microörganism. A stab culture in sugar agar from pus beneath the diaphragm in the region of the spleen developed a mixed growth of bacteria. Cultures on coagulated Löffler's blood serum made at the same time from the abscesses in these various situations, as well as from the spleen, showed the presence of a few unknown bacteria of different kinds, which were not regarded as being of any special importance in the production of the lesions. Their presence in these cultures is accounted for by assuming that a larger amount of pus and other material was used for inoculation than in the case of the agar stab cultures. The culture on blood serum from the blood of the heart showed no growth.

This case is regarded as being primarily a pure infection with the specific microörganism. The other bacteria encountered are considered to be secondary invaders.

Case II. — *Actinomycosis of Jaw* (Service of Dr. C. A. Porter):

Granules characteristic. Clubs present. Cultures in bouillon made from the granules developed an abundant growth of bacteria and a bad odor. Later pure cultures obtained of the specific microörganism.

Case III. — *Actinomycosis of Jaw* (Service of Dr. G W. W. Brewster):

Granules typical. Clubs present. Granules placed in bouillon and a contamination with a long slender bacillus developed. Later a pure culture obtained by means of anaërobic sugar agar plates prepared from bouillon cultures.

Case IV. — *Actinomycosis of Thorax* (Service of Dr. R. B. Greenough):

Granules typical and showing clubs at the periphery Culture developed contaminating bacteria. Specific microörganism isolated by means of sugar agar suspension culture.

Case V. — *Actinomycosis of Jaw* (Service of Dr. C. A. Porter):

Granules typical. Clubs present at the periphery. Mixed infection with various kinds of bacteria. No record preserved of the mode of isolation.

Case VI. — Actinomycosis of Cheek (Service of Dr. E. A. Codman):

Granules typical. Clubs present. Mixed infection, other microörganisms being present. Exact method of isolation not recorded.

Case VII. — Actinomycosis of Liver (Service of Dr. J. W. Elliott):

The granules are filamentous and do not show clubs. Mixed infection with bacteria. Cultures in bouillon fail to grow at first, but a pure culture eventually obtained by means of sugar agar.

Case VIII. — Actinomycosis of Spine in the Cervical Region (Material received from Dr. F. B. Mallory):

Granules typical and showing clubs. Mixed infection with bacteria. Specific microörganism isolated by means of sugar agar suspension culture.

Case IX. — Actinomycosis of Anterior Abdominal Wall (Service of Dr F. B. Harrington):

Two or three fragments of bone, apparently chicken bone, found in the lesions. Granules present, some of which show clubs. Culture on blood serum developed, at the time of the first operation, no growth of bacteria. Cultures made from the material obtained at the second operation showed a mixed infection.

Case X. — Actinomycosis of Jaw (Service of Dr. C. L. Scudder):

Clubs present at the periphery. Characteristic granules and clubs present. Mixed infection. Mode of isolation not recorded.

Case XI. — Actinomycosis of Jaw (Service of Dr. F. G. Balch):

No record of appearance of granules nor of mode of isolation; presumably isolated by bouillon culture.

Case XII. — Actinomycosis of Jaw (Service of Dr. W. W. Conant):

Typical granules with clubs. Cultures show apparently a pure infection with a specific microörganism. Pure cultures obtained by means of sugar agar suspension cultures.

Case XIII. — Actinomycosis of Thorax (Service of Dr. M. H. Richardson):

Characteristic granules with clubs. Granules dried on side of sterile test-tube from March 9 to March 27, when sugar agar suspension was made. In this there developed two colonies, one composed of an organism like the specific microörganism and the other composed of a longer branching microörganism which grew aërobically and easily on culture media. On April 7 another sugar agar suspension culture made from the dried granules. In this tube probably half a dozen colonies of the specific microörganism developed without contaminating colonies.

Case XIV. — Actinomycosis of Jaw (Bovine) (Material received from Dr. Austin Peters):

Typical granules with clubs. Mixed infection. Specific microörganism isolated by sugar agar suspension culture.

Case XV. — *Actinomycosis of Omentum of Cow* (Material received from Dr. Langdon Frothingham):

Typical granules with clubs. A pure culture obtained by means of a sugar agar suspension after drying the granule on the side of a test-tube from May 12 to June 3. Many contaminating bacteria present.

CULTURAL CHARACTERS. — One per cent dextrose or glucose agar suspension cultures. The microörganism from all of the thirteen cases grows in essentially the same manner in this form of culture. If the amount of material used for inoculating the tube is not too large, and if it be thoroughly distributed throughout the medium, the culture presents the following appearances: In the course of two to four days in the incubator colonies appear scattered throughout the depth of the agar, but are very few or absent throughout that portion of the agar five or ten millimeters immediately below the surface. Throughout a shallow zone about two to four millimeters wide the colonies are very numerous and minute, producing frequently the appearances of a dense grayish cloudiness in the medium. This zone where the colonies are so very numerous lies at a point about five to ten millimeters below the surface. Below this zone the colonies are much less numerous (see Fig. 2). The appearances in these cultures show that the microörganism is essentially an anaërobe. This greater rapidity and luxuriance of growth of the microörganism in the region of this zone a short distance below the surface is shown also by other anaërobes in sugar agar suspension cultures. It might be explained as the result of a stimulating action exerted upon the growth of the microörganisms by the presence of a small amount of oxygen which has penetrated into the medium from the surface.

The colonies occupying this zone are often excessively numerous and in a very few days most of them cease to enlarge. The colonies below this zone, as a rule, never become so numerous as in the zone, but they grow larger. In the course of a few days they appear as irregularly spherical or nodular opaque grayish white masses, and may attain a diameter of two or three millimeters in the course of a week or ten days in the incubator.

Under the microscope the smaller colonies are seen to be spherical masses of branching filaments arranged generally in a radiate manner. The branching is true, and not the false branching of cladothrix. As the colony grows older more and more branches are generally formed from the filaments, and the branches and filaments show a marked tendency to break up into segments, so that the colony may become a compact mass of short filaments and bacillus forms. The larger colonies, under the microscope, consist of closely packed opaque masses of the microörganism, and branching is not visible.

Permanent preparations of the colonies showing the branching, radiating, filamentous structure of the smaller colonies are easily obtained by making sections of the agar agar cultures and staining by Gram's or Weigert's methods.

For this purpose Wright's frozen section method[1] has been found well adapted.

The colonies from one of the cases (Case XIV.) did not stain well by Gram's method, but did stain by Weigert's method.

The microscopical appearances of the colonies in sugar agar suspension cultures are shown in figures one, three to thirteen, and sixteen.

Stab cultures in sugar agar. — Most of the strains have been tested in this form of culture and all have grown only in the depths of the medium, no growth occurring in that portion of the line of inoculation immediately below the surface of the agar. The microörganism thus behaves like the obligate anaërobic bacteria. The growth appears as a dense grayish streak or line of small nodules along the line of inoculation, not spreading much into the medium.

Bouillon. — Growth occurs in bouillon in the form of solid whitish masses at the bottom of the tube; there is never growth at the surface. When first isolated from the lesions these masses of growth appear in the form of nodular, irregularly spherical structures, often coherent to one another and forming mulberry-like masses, but under continued cultivation most of the strains of the microörganism finally grow in the form of flaky, friable amorphous masses which in some instances after some days in the incubator become transformed into a stringy viscid material. One strain of the microörganism (Case VIII.), although under cultivation for months, still retained the coherent mulberry-like character of its growth in bouillon.

The volume of the growth of the microörganism in bouillon depends upon the amount of bouillon in the tube. In a tube containing about seven cubic centimeters of bouillon the volume of the growth never becomes larger than that of a small pea. The growth on most of the strains attains its maximum development in the course of about five or six days in the incubator. One of the strains (Case XII.) grew in bouillon more slowly than the others.

The bouillon is not clouded by any of the strains except one (Case XIV.). With this the bouillon slowly becomes clouded, but nearly all of the growth is in the form of nodular masses at the bottom of the tube. The clouding is seen to be due to the presence of fragments of the microörganism in suspension. No growth was obtained in transplants made from the cloudy fluid, and the fragments of the microörganism in suspension are considered to be degenerate or dead.

In general, growth appears to be as luxuriant in bouillon either under aërobic or anaërobic conditions. The microorganism grows under aërobic conditions probably because in the compact masses that it forms anaërobic conditions practically exist.

Cover-glass preparations made by breaking up and spreading upon a cover-glass portions of the growth in one per cent dextrose or glucose bouillon show longer and shorter rods and filaments sometimes branching. The rods and filaments are in general of about the diameter of the diphtheria bacillus, but their thickness varies considerably. Like the diphtheria bacillus also the microörganism shows deep-stained areas and points in its protoplasm.

The accompanying photographs (Figs. 17 to 30) show very well the morphology in sugar bouillon cultures, so that no extended description is necessary.

The organism appears to grow generally in longer forms in sugar bouillon than in plain bouillon. The microörganism from Case I. showed a very marked development of pear or olive-shaped swellings at the ends of the rods in plain bouillon cultures (see Fig. 47).

The character of the colonies in sugar agar, as above described, make it plain that the appearances in cover-glass preparations from bouillon cultures do not show the true morphology, but that the separate rods and filaments result from the disintegration and tearing apart of a branching microörganism. The true morphology is shown only in the small colonies in sugar agar cultures.

Slant cultures on solid media.—The media employed for slant cultures have been ordinary nutrient agar agar, glycerine agar agar, sugar agar agar, and coagulated Löffler's blood serum. Each of the fifteen strains of the microörganism was tested on one or more of these media in "slant tubes" both anaërobically and aërobically. The growths thus obtained have in no instance been luxuriant, but in some instances no growths at all have resulted. In fact, the microörganism seems to be but ill adapted for surface growth.

This is further shown by the fact that in sugar agar suspension cultures, placed under anaërobic conditions, there is little or no tendency to form colonies on the surface. If the surface of the medium be inoculated with an abundance of material, growth may take place in the form either of thin patches of small grayish nodular masses or in the form of a few well separated colonies which may attain a diameter in the course of a week or ten days of a few millimeters. These colonies may appear as heaped up whitish opaque irregular or rosette shaped masses, or they may be circular in outline with a central elevated portion and present nothing characteristic.

The microörganisms from Cases VIII. and XIII. especially show markedly irregularly-shaped surface colonies. With the microörganism of Case XII. no definite surface growth was obtained.

Inasmuch as the growth on the surface of slant culture tubes is thus so little luxuriant and so uncertain under either aërobic or anaërobic conditions, no definite conclusion seems to be justified from the comparison of the growths under aërobic and anaërobic conditions. With some of the strains one or the other mode of cultivation seemed to give somewhat better results. The observations are so contradictory that it does not seem worth while to report them in detail.

The appearances of surface colonies of some strains of the microörganism are shown in figures thirty-one and forty.

Potato cultures in tubes.—Fourteen of the fifteen strains were planted on potato, and all except two were observed under both anaërobic and aërobic conditions. In no instance was anything like a luxuriant growth obtained. A very slight or doubtful growth was observed in the aërobic potato cultures from Cases IV. and V. and in the anaërobic culture of Case VIII. In some instances there seemed to be a growth in the fluid at the bottom of the tube.

Potato infusion cultures.—These were made with the strains from Cases III., V., VI., VII., and VIII., and placed under anaërobic conditions. In no instance was evidence of growth obtained except in one tube, Case III., in which there might have been some slight growth.

Pepton solution.—Transplants into pepton solution were observed in most instances under aërobic conditions. The strains from the Cases II., III., IV., V., VI., VII., VIII., XII., and XIV. were tested. None of them grew in pepton solution except Case XIV., which showed a doubtful growth.

Litmus milk.—Litmus milk tubes were inoculated with the strains from Cases I., II., III., IV., V., VI., VII., VIII., IX., X., XII., XIII., XIV., and XV., that is, with fourteen of the strains. Tubes were maintained in most instances under both anaërobic and aërobic conditions. Some slight or doubtful growth was observed only with the strains I., II., III., VII., IX., XIII., and XV. There was no evidence, however, that milk is a favorable culture medium for the microorganism.

Beerwort. — Aërobic cultures in unfermented beerwort were prepared with the strains from Cases II., III., V., VI., VII., and XIV. No growth was obtained with any of the strains.

Oat infusion. — The oat infusion was prepared either from the whole oats or from oatmeal. Cultures under aërobic conditions were made from the Strains II., III., V., VI., VII., and XIV. No growth was obtained.

Egg cultures. — These were made either in the whole egg after it had been boiled for about three minutes, through an opening made in the shell, the material for inoculation being placed in the yolk, or the yolk of the egg, sometimes mixed more or less with the white, was transferred to sterile test-tubes and these then inoculated. Egg cultures were thus made with the strains from Cases I., II., III., V., VI., VII., VIII., XII., XIII., and XV. In a few instances the egg material in the test-tube was kept under anaërobic conditions. None of the strains showed anything that might be called a luxuriant growth in these cultures. A slight growth only was noted in the strains from Cases II. and III. Microscopical examination of the growth in Case II. showed some very long filaments staining irregularly and as if degenerate.

Relation of growth to temperature. — Growth was observed practically only at about 37° C.

One per cent dextrose or glucose gelatin suspension cultures, made from the strains from Cases II., III., IV., VI., VII., VIII., XII., XIII., XIV., and XV., and maintained at room temperature for more than two months, showed no growth. Other cultures of the same kind from the strains from Cases II., III., V., VI., VII., and XIV., kept at room temperature for more than a month in the summer time, all showed a doubtful or slight growth which was probably due to the relatively high room temperature.

Stab cultures or suspension cultures in sugar agar, prepared with the strains from Cases II., III., IV., V., VI., VIII., XII., and XIV., and kept at room temperature, in no instance showed well-marked growth. In a few instances a slight or doubtful growth occurred after a long time.

Bouillon culture-tubes, inoculated with the strains from Cases I., II., III , VI., and XIV., were kept at room temperature, but no growth resulted except in the culture from Case XIV., in which some growth was apparent after about six weeks.

All the observations show that the room temperature is not at all favorable for the growth of any of the strains of the microörganism tested.

Vitality. — Resistance to drying was tested by placing portions of growths in bouillon or sugar agar on the sides of sterile test-tubes and keeping them at room temperature in the dark for varying lengths of time. This test was made with the strains from Cases II., III., IV., V., VI., VII., VIII., XII., XIII., XIV., and XV. After varying lengths of time sugar agar suspensions were made from the dried material and placed in the incubator. The results obtained have been quite variable, but in general they show that the various strains are quite resistant to drying under these conditions.

The maximum length of time that the various strains of the microörganism were found to survive is as follows:

Case III., fifty days; Case IV., fifty days; Case V., fifty days; Case VI., fifty days; Case VII., fifty days; Case VIII., eighty days; Case XII., fifty-one days; Case XIV., fifty days.

The vitality of the microörganism in cultures is variable. In general it does not seem to survive as long in cultures as when dried on the sides of test-tubes. It seems to live longer in sugar agar cultures than in bouillon cultures.

Transplants from bouillon cultures that have been six to ten days in the incubator may fail to grow. Cultures in sugar agar may die out or become incapable of transplantation after having been kept some days in the incubator and afterwards a few weeks at room temperature. On the other hand the strains from Cases III., V., VI., and VIII. were found to be alive after having been eighty-three days in sugar agar at room temperature, as shown by the development of colonies in the tubes when they were placed in the incubator. Under the same conditions the strains from the Cases II., IV., and VII. did not grow.

Thermal death point. — From the strains from Cases II., III., IV., V., VI., VII., VIII., XIII., XIV., and XV. sugar agar suspension cultures were prepared and immediately heated in a water bath to 62–64° C. for ten or eleven minutes and then placed in the incubator. No colonies developed in any of the tubes. From the strains from Cases II., III., V., VI., and XIV. sugar bouillon cultures were prepared and immediately heated in the water bath at about 60° C. for fifteen minutes. The tubes afterward did not develop any growth in the incubator. From the strain from Case XII. a sugar bouillon culture was heated at 62° C. for three minutes in a water bath. A transplant was then made in sugar agar and placed in the incubator. No growth developed.

Staining reaction. — All strains of the microörganism stain well by Gram's method except that from Case XIV., which behaves ambiguously. In sections of the lesions both original and experimental, and in sections of sugar agar cultures, this strain is decolorized or stains only faintly by Gram's method. In smear preparations from bouillon cultures it stains irregularly or the staining is confined to small areas in its protoplasm.

Smear preparations of the microörganism from sugar bouillon cultures of the strains from Cases II., III., IV., V., VI., VII., VIII., XIII., XIV., and XV. were not found acid fast towards Gabbet's decolorizing solution after staining with carbol fuchsin.

"Club" formation in cultures. — No one who has worked with cultures of true Actinomyces has shown that it is capable of forming true "clubs" in cultures. By true "clubs" I mean those structures resulting from the formation of a hyaline layer or sheath about the extremities of filaments, which sheath stains with eosin and not by Gram's method. Certain swellings of the filaments as a whole, which have been described in culture by some writers as clubs, I do not accept as corresponding to the clubs in the lesions.

Bostroem claims to have seen club formation in the cultures of his microörganism, but as will be pointed out later it is very doubtful whether he has worked with the specific microorganism of actinomycosis.

With the idea of determining whether the microörganism would form the characteristic "clubs" outside of the animal body, growths from bouillon cultures were placed in various fluids, among which were tried bouillon containing four per cent sodium chloride, with or without one per cent dextrose; pus and serous pleuritic fluids; human, horse, and beef blood serum. In bouillon containing four per cent sodium chloride good growth was obtained, but never any clubs. In the other fluids true clubs were obtained in some of the experiments, but no growth or only a slight growth was ever observed. It is clear from this work that the animal fluids experimented with are not good culture media for the microörganism. The formation of clubs in these experiments seems to depend on certain unknown factors not always present, for club formation was not always obtained.

Positive results were obtained only with blood or blood serum or with serous pleuritic fluids, but the results were not constant. The best results in general were given by the serum of blood rich in fibrin, obtained through venesection in cases of pneumonia, and also by pleuritic fluids yielding a fibrinous clot rapidly.

The serum or other fluid was placed in test-tubes under suitable precautions to prevent contamination. To it was transferred by means of the platinum loop the growths of the microörganism in four per cent sodium chloride or sugar bouillon, and the tube then placed in the incubator. The growths in four per cent sodium chloride bouillon were used in some instances, because it was thought that the organism grew in longer filaments in this culture medium.

It should be understood that the possibility of carrying over "clubs" from the original material was carefully excluded.

Transformation into clubs was observed only in those filaments in immediate contact with the fluid, thus the club formation could be seen only at the periphery of the globular masses of the microörganism or in small detached fragments of the growth.

The club formation consisted essentially in the appearance of a hyaline eosin-staining sheath or layer investing the filament and often being several times as thick as the filament itself. Not all filaments freely exposed to the fluids showed this transformation. In many instances only a few of the filaments showed the transformation into clubs. In many instances the filaments in the center of the club-shaped structure was absent or represented by a faint pale line. The club-shaped structures which had attained considerable size seemed to be easily broken up. The presence of the clubs could be readily observed by direct examination under the microscope of portions of the growth placed upon a slide and covered with a cover-glass.

The clubs were best shown in paraffine sections of the club-bearing vegetations, stained according to the principles of Mallory's method[1] for actinomycotic tissue No. 1. On account of the small size of these vegetations they were difficult to carry through the paraffine imbedding process without losing them and without considerable care. The following method for imbedding them was found to give satisfactory and quick results.

The vegetations are placed in a few cubic centimeters of ninety-five per cent alcohol in a test-tube and the alcohol allowed to act upon them for a few minutes. The alcohol is then poured off and absolute alcohol substituted. This is allowed to act for an appropriate length of time until dehydration could be regarded as complete. The absolute alcohol is then poured off and replaced by xylol. Xylol is employed because of its low specific gravity, which does not permit of the vegetations floating in it as in chloroform. When the vegetations are "cleared" the xylol is poured off, and melted paraffine poured in. During a few minutes the tube is warmed from time to time in the flame in order to keep the paraffine fluid, and then the tube is so manipulated that the vegetations come to lie together in the bottom of the tube in as compact a group as possible. When this has been attained the tube is quickly placed in cold water and the paraffine allowed to solidify. When the paraffine is solid, the bottom of the tube is hastily warmed in the flame and immediately sharply struck against a hard surface in order to shatter the glass. The fragments of glass are then removed from the mass of paraffine, and a cast of the bottom of the tube in paraffine is obtained which contains the vegetations at its surface and clearly visible. This cast may then be mounted on the microtome and sections cut. The object of warming the bottom of the tube before shattering the glass about the solidified paraffine is to obviate the firm adhesion of the glass fragments to the paraffine. If it is not done the glass fragments are removed only with the greatest difficulty from the paraffine surface. The warming serves to partially melt portions of the paraffine in contact with the glass, and if the glass is shattered before the paraffine has time to cool most of the fragments will not stick to the paraffine.

In the manner above described club formation was demonstrated with the microörganisms from Cases II., III., IV., V., VI., VII., VIII., and XIV. A small number of experiments were also tried with the microörganism of Cases XII. and XIII. with negative results.

The appearances of the club formation in these fluids is shown in Figures 14, 15, 32, 33, 34, 35, 37.

Inoculation experiments on animals.

Inoculation experiments have been made with cultures of the microörganism from thirteen of the cases. Guinea-pigs and rabbits have been mostly used, and most of the animals have been inoculated in the peritoneal cavity. Most of the inoculations have been made with bouillon cultures, and others have been made with agar cultures.

The results have been more satisfactory with bouillon cultures because the particles of agar agar carried in with the organism regularly provoke the formation of granulation tissue about them and become encapsulated, so that tumor nodules are formed which obscure the effects produced by the microörganism. The presence of the agar agar in the tissue does not seem to favor the production of more extensive lesions properly referable to the microörganism alone.

In a few experiments, with the idea of creating more favorable conditions for its action on the tissue, along with the microörganism, silk setons were placed in the tissues or sterile oat grains were placed in the peritoneal cavity or melted butter was injected into the peritoneal cavity. None of these experiments indicated that the multiplication and pathogenic action of the microörganism were favored by these means.

The results of the inoculations were by no means constant. Many were without definite result. A very few animals developed suppurative processes not apparently due to actinomyces. In no instance was a progressive actinomycotic process produced.

With some strains of the microörganism, however, relatively extensive lesions were obtained which anatomically and histologically were identical with those of typical actinomycosis. The lesions produced were in the form of nodules varying in diameter from less than one millimeter to ten or twelve millimeters. Most of the larger nodules were less than six millimeters in diameter. The nodules consisted of connective tissue in varying stages of development and, in typical instances, enclosing one or more cavities filled with pus and containing the characteristic colonies of the microörganism with clubs. Some of the smaller nodules consisted essentially of a colony of the microörganism surrounded by epithelioid cells and connective tissue. The nodules resulting from intraperitoneal inoculation were situated chiefly on and in the great omentum. In some instances they were so small and so intimately associated with the fat tissue that they were found only with difficulty. The most marked lesions obtained were by intraperitoneal inoculation and chiefly with strains of the microörganism that had been under cultivation only for a short time. The experiments are described in detail below.

In connection with these experiments in which relatively extensive lesions were produced it should be said that little evidence was obtained that the microörganism had multiplied to any marked extent in the body of the animal. It seems probable that some multiplication had occurred in two or three of the experiments, but as a rule it did not seem to be true that the number of colonies was any greater than the number injected into the peritoneal cavity.

The microörganism, however, does not act merely as an inert foreign body in many of the experiments, but in the better developed lesions the mass of tissue produced about the colonies and the amount of suppuration in the nodules were usually much greater than in the experiments with implantations of agar agar, setons, or oat shells, and the nodules were often very many times larger than the colonies they contained.

The failure of these inoculation experiments to demonstrate an active infectious action by the microörganism is not surprising in view of the fact that inoculation of various kinds of animals with actinomycotic granules and material from actinomycotic lesions at the hands of many experimenters has given only either negative or ambiguous results.

I have gone over the results of thirty-five (2–36) experimenters who have, altogether, performed a large number of such inoculations. Excluding those whose results were vitiated by sepsis, about half of these reports show negative results. None of the experiments for which positive results are claimed convincingly show that an active, progressive, infectious process had been produced. All of them are open to the serious objection that the lesions were the products of the reaction of the tissue to the injected material as to a foreign body, and that there had been no active growth of the microörganism.

The following reports of two authors will give a fair idea of the results of such inoculation experiments.

Mayo[24] inoculated guinea-pigs, four cattle, and one dog with material from bovine actinomycosis. Thirty-seven inoculations were made with pus containing club-bearing colonies. All of these gave negative results. Fourteen experiments were made with actinomycotic tissue containing the actinomyces in a growing stage. These gave eight positive results, and characteristic actinomycotic tumors were produced. In all the positive cases the inoculation wound healed, and in fourteen to twenty-seven days the small fibrous nodule began to enlarge and eventually assume the characteristic appearance. No other details of the positive experiments are given, except a photograph of a cow showing a tumor of the upper jaw about the size of the fist.

Rotter[11] performed numerous inoculation experiments with human material on calves, swine, dogs, guinea-pigs, and rabbits. The human material came from thirteen cases. In only one case was a positive result obtained. This was in a rabbit that had been inoculated in the peritoneal cavity with a mass of actinomyces contained in a piece of skin the size of a pea. Six months afterwards the animal was killed, having appeared healthy meanwhile. At the autopsy of the animal there were found twenty pin-head to hazel-nut sized tumors, which, in their alveolar structure and content of actinomyces colonies, were typical of actinomycosis. Only in the smaller and medium sized tumors were colonies of the microörganism capable of being stained. The larger tumors contained in their alveoli only detritus and indefinite masses. The original piece of skin was found encapsulated in the peritoneal cavity and the colonies contained in it were apparently dead, for they would not stain by Gram's method.

In brief it may be said that the microörganism of actinomycosis shows little or no infectious activity in inoculation experiments. It would seem that other factors beside the microörganism must play a prominent part in the production of a progressive actinomycosis.

In order to save space in the following summary of my experiments on animals, details of the negative and inconclusive experiments will be omitted.

For the histological study of the lesions, paraffine sections of the tissue, fixed in alcohol, formaldehyde, or Zenker's fluid, have been employed. For the study of the colonies in the lesions, fixation in alcohol or formaldehyde is preferable to Zenker's fluid, which is better for general histological purposes. The sections were stained according to the principles of Mallory's method No. 1.[1] In many instances alcohol was substituted for anilin oil in Step 7 of the method, as this seemed to better differentiate the clubs and filaments after alcohol and formaldehyde fixation. In Step 4 water was used instead of normal salt solution.

Case I. — Five rabbits and two guinea-pigs were inoculated in various ways. Only one animal, a rabbit, developed definite actinomycotic lesions. This animal was inoculated in the peritoneal and thoracic cavities with a bouillon culture, and was killed after thirty-four days. The microörganism had been under cultivation nineteen months when the animal was inoculated. In the peritoneal cavity a firm tumor about ten millimeters in diameter was found attached by a pedicle to the abdominal wall. In the subcutaneous tissue near the point of inoculation a mass of inflammatory tissue about ten millimeters in greatest dimension. Paraffine sections of the tumor in the abdominal cavity showed typical actinomycosis. The tumor was composed of more or less well-developed connective tissue and contained abscesses in which were typical colonies, one of which showed well-developed clubs (see Fig. 51).

Among the negative inoculations the following may be mentioned:

Silk setons were placed in the tongue, liver, and muscular tissue of one of the hind legs of a rabbit, and in the situation of the seton the growth from bouillon cultures was injected. The animal was killed after about two months. The autopsy failed to show any lesions of actinomycosis either grossly or microscopically. The microörganism had been under cultivation for more than five months when this animal was inoculated. This was the first inoculation experiment with this strain of the microörganism.

In another experiment a rabbit was inoculated with bouillon cultures in an ear vein and in the mesenteric vein, as well as in the leg. The animal was found dead twenty-three days after inoculation. The autopsy showed no lesions that could be regarded as actinomycotic. There were suppurative foci in the abdominal cavity.

Case II. — Ten guinea-pigs and two rabbits were inoculated. Most of the inoculations were made in the peritoneal cavity. Only one animal, a rabbit, developed lesions worthy of special mention. This was the first animal inoculated after the isolation of the organism and when it had been under cultivation three months. It is presumable that this strain had undergone some attenuation. This rabbit was inoculated in the following manner: Silk setons were placed in the tongue, in the liver, and in a leg muscle, and in the region of the setons a bouillon culture was injected by means of a hyperdermic syringe. The animal was killed after forty-one days. The seton was present in the tongue, but only microscopic actinomycotic lesions were associated with it. There were fibrous adhesions about the liver and the great omentum. About the seton in the liver a slight amount of connective tissue formation. At one point in the liver in connection with the seton was a split pea sized cheesy nodule surrounded with a capsule. About the seton in the leg was some development of connective tissue, and associated with it and in the neighboring muscular tissue several nodules less than one millimeter in diameter. These nodules consisted of connective tissue and cells and enclosed actinomyces colonies with clubs. Paraffine sections of the nodule in the liver and of other lesions showed typical actinomycotic appearances. The colonies in the lesions show well-developed clubs (see Figs. 45 and 56).

Among the experiments in which the lesions produced were insignificant, it may be mentioned that one of them was an oat shell implantation in the peritoneal cavity.

Case III. — Thirteen animals were inoculated in various ways, most of them in the peritoneal cavity. In none of the animals were extensive lesions obtained referable to the microörganism, and most of them did not show any lesion which was actinomycotic in character. Among the negative results were the following: One oat-shell transplantation, one injection of butter into the peritoneal cavity, and one in which inoculations were made both in the ear vein and in the mesenteric vein. The microörganism had been under cultivation about six weeks when this last-mentioned experiment was made. The only satisfactory experiments were the following:

A guinea-pig inoculated in the peritoneal cavity with a bouillon culture and found dead or killed after twenty-four days. Nodules were present at the point of inoculation and in the omentum. Paraffine sections of only two nodules preserved. The sections from one of the nodules, presumably from the omentum, show that the lesion was about six millimeters in greatest dimension. It consists of a granulation tissue formation enclosing small cavities in which are colonies of actinomyces with more or less pus. The colonies have no clubs. The appearances are those of typical actinomycosis, except that the colonies do not present clubs. The sections of the lesion at the point of inoculation show new formation of connective tissue with suppurative foci, and at one or two points an actinomyces colony without clubs. This animal had been inoculated when the microörganism had been under cultivation more than fourteen months.

Another guinea-pig was inoculated in the peritoneal cavity with a sugar bouillon culture and killed on the twenty-fifth day. Attached to the great omentum and to the anterior abdominal wall a yellowish white mass ten by two by three millimeters. Also attached to the omentum were two or three small nodules, the largest about two or three millimeters in diameter, and one small nodule about one millimeter in diameter attached to a seminal vesicle. Microscopical examination shows typical appearances of actinomycosis, and the colonies have clubs. This animal was inoculated after the microörganism had been under cultivation for about three and one-half years (see Fig. 53).

Case IV. — Five guinea-pigs and one rabbit inoculated in the peritoneal cavity. In but three animals (guinea-pigs) were lesions referable to the organism produced and these were very small. The best results were obtained in a guinea-pig inoculated with portions of a sugar agar suspension culture in the peritoneal cavity. The animal was killed on the fifty-second day after inoculation. Rather numerous masses of agar agar were found imbedded in the omentum. The largest mass was eight to ten millimeters in greatest dimension. Paraffine sections showed inflammatory tissue investing the fragments of agar agar, and in this tissue a few well-developed and characteristic actinomyces colonies with clubs were found (see Figs. 36, 45, and 55).

Case V. — Six guinea-pigs were inoculated in the peritoneal cavity with bouillon cultures. The first animal was inoculated after the microörganism had been under cultivation for more than seven months. Attenuation by long cultivation may account for the negative or insignificant results of the animal experiments. Of the six animals only one showed definite lesions which may be regarded as actinomycotic. This animal was inoculated with a small amount of the rather firm and coherent growth in an anaërobic sugar bouillon culture. It was killed thirty-eight days afterwards. In the omentum only two nodules were found much less than pin head in size. Sections of one of the nodules showed that it consisted of a small connective tissue mass surrounding a colony with clubs (see Fig. 54).

Among the negative experiments with this strain it may be mentioned that in one a sterilized oat shell was inserted in the peritoneal cavity, and in another melted sterilized butter was injected in the peritoneal cavity with the microörganism.

Case VI. — Nine guinea-pigs, three rabbits, and one brown mouse were inoculated, but positive actinomycotic lesions were obtained in but one animal, a guinea-pig. Only three of the animals, namely, this guinea-pig, a rabbit, and the mouse were inoculated within two weeks after the isolation of the microörganism. All of the others were inoculated after it had been under cultivation for more than two years, so that the negative results may be partly explained as due to attenuation by cultivation. The guinea-pig which gave positive results was inoculated with the growth in sugar bouillon in the peritoneal cavity, in the mamma, and in the leg. The animal was found dead on the thirteenth day. In the subcutaneous tissue about the mamma several ill-defined minute nodules and in the muscles of the leg a few minute grayish nodules. Microscopical examination of teased preparations of the nodules in these situations showed actinomyces colonies surrounded by granulation tissue and cells. In the tissue about the groin there was a small nodule less than pin head in size. Adherent to the great omentum was an ill-defined nodule four to five millimeters in diameter. On section it consisted largely of a yellowish firm tissue and presented two actinomyces colonies. At another point in great omentum was another smaller nodule. Paraffine sections of nodules from various situations showed granulation tissue masses enclosing small abscesses and aggregations of epithelioid cells in the midst of which are scattered actinomyces colonies. Only one or two of the colonies presented a few club-like thickened filaments at the periphery. The lesions had probably not existed long enough for the development of typical clubs in the colonies. Some giant cells were observed in the lesions (see Fig. 38). In another guinea-pig inoculated by placing in the peritoneal cavity a sterilized oat shell smeared with the microörganism developed only an insignificant lesion, but in the pus associated with the oat shell one small colony with typical clubs was found. As in other similar experiments the presence of the oat shell did not seem to exert any more effect than producing a localized inflammatory process.

Case VII. — Six guinea-pigs inoculated in the peritoneal cavity. Four of the animals failed to develop lesions like actinomycosis. In the peritoneal cavity of one of these guinea-pigs a sterilized oat shell had been implanted, and in the peritoneal cavity of another sterilized melted butter had been injected. Of the two guinea-pigs that developed characteristic lesions, one was killed thirty-two days after inoculation. At the autopsy three nodules one to four millimeters in diameter were found attached to the omentum. Paraffine sections show typical actinomycotic lesions and colonies with clubs presenting secondary degenerative changes (see Figs. 48, 50, and 57). The other guinea-pig was inoculated within a short time after the isolation of the microörganism and was killed on the fourteenth day. At the seat of inoculation in the subcutaneous tissue there was a small granulation tissue mass one by three millimeters. Attached to the omentum were two or three nodules two or three millimeters in diameter. Paraffine sections showed the usual appearances of actinomycotic tissue, but the "clubs of the colonies" were not many and not generally large.

Case VIII. — Three guinea-pigs were inoculated in the peritoneal cavity with bouillon cultures. All the animals developed characteristic lesions with clubs. The first guinea-pig was inoculated after the microörganism had been under cultivation but eleven days, and the animal was killed on the twenty-seventh day after inoculation. Attached to the omentum were about eight nodules, the larger three or four millimeters in diameter. Paraffine sections show typical lesions with club-bearing colonies (see Fig. 44).

Another guinea-pig was inoculated a few days after the first, a sterilized oat shell being placed in the peritoneal cavity. The animal was killed on the sixty-eighth day. The lesions were not so extensive as in the preceding animal, showing that the foreign body exerted no effect in the way of increasing them.

The third guinea-pig was inoculated with a bouillon culture of the microörganism obtained from the first guinea-pig. The microörganism had been under cultivation for sixteen days from the guinea-pig. The animal was killed on the one hundred and fourth day after inoculation. In the great omentum were found about fifteen nodules one to five millimeters in diameter. Paraffine sections showed typical actinomycotic lesions. Some of the colonies had large clubs with spicules on them (see Fig. 42). This experiment suggests that the virulence of the microörganism had been somewhat increased by passage through the guinea-pig.

Case XI. — A rabbit was inoculated in the peritoneal cavity with a bouillon culture and was found dead after one hundred and three days About twelve yellowish nodules were found adherent to the mesentery of the large intestine. The largest of these was about the size of a pin head. Several similar nodules were found on the peritoneum elsewhere. Several parasitic cysts were present in the abdominal cavity. Paraffine sections were preserved of only one nodule. This showed a typical club-bearing colony encapsulated by connective tissue (see Fig. 43). This animal had been inoculated when the microörganism had been under cultivation twenty-two days. A guinea-pig inoculated a few days later in the peritoneal cavity with a bouillon culture was found dead after about a month. A few small nodules were found in the omentum and at the site of inoculation.

Case XII. — A guinea-pig inoculated in the peritoneal cavity with a bouillon culture was killed thirty-four days after inoculation. The microörganism had been under cultivation twenty-one days. In the great omentum were eight nodules one to three millimeters in diameter. Paraffine sections show typical appearances of actinomycosis. The colonies had no clubs.

Another guinea-pig was inoculated in the peritoneal cavity with bouillon culture and was killed sixty-two days after inoculation. The microörganism had been under cultivation twenty-seven days. In the subcutaneous tissue one nodule the size of a pin head. Adherent to the liver and to the great omentum was an irregular resistant mass about one centimeter in diameter. Elsewhere in the omentum one nodule of pin head size. Paraffine sections of lesions show typical appearances of actinomycosis with typical club-bearing colonies. Sections of the large lesion show apparent invasion of the liver tissue (see Figs. 39 and 41).

Case XIII. — Two guinea-pigs were inoculated in the peritoneal cavity. One animal was killed fifteen days after inoculation. In the subcutaneous tissue at the point of inoculation several nodules, the larger one to two millimeters in diameter. Attached to the omentum were six or eight nodules, the largest six millimeters in diameter. Paraffine sections of lesions show a process like actinomycosis. Clubs present in but one colony. The process is not old enough for clubs to extensively develop.

The other guinea-pig was killed thirty-one days after inoculation. Attached to the omentum were three or four more or less confluent nodules, the largest eight to ten millimeters in diameter. Attached to the liver was one nodule two millimeters in diameter. Sections of a nodule show a typical actinomyces colony with large clubs (see Fig. 49).

Case XIV.— Seven guinea-pigs were inoculated in the peritoneal cavity. Two of these were also inoculated in the subcutaneous tissue. One animal inoculated early in the series failed to develop any lesion. The other animals did develop actinomycotic lesions. This strain of the microorganism was remarkable for the rapidity with which its colonies would form clubs in the tissues; thus clubs were found in colonies in the lesions of an animal killed only four days after inoculation.

A peculiarity of this strain of the microörganism is that it did not stain well by Gram's method either in the original lesions or in the experimental lesions. It also rapidly lost its property of staining by Weigert's method in the experimental lesions.

One of the guinea-pigs was inoculated with bouillon cultures after the organism had been under cultivation twenty-six days. The animal was killed thirteen days after inoculation. In the right groin was a nodular mass about eight millimeters in diameter. On section the mass was seen to contain purulent foci, and colonies with clubs were present in the pus. Attached to the intestine and mesentery were three or four nodular masses, the largest three to four millimeters in diameter. One nodule one millimeter in diameter was attached to the diaphragm. Colonies planted in bouillon and sugar agar failed to grow.

Another guinea-pig was inoculated when the microörganism had been more than four and one-half months under cultivation. The animal was killed after eight days. In the great omentum seven or eight nodules, the largest three to four millimeters in diameter. Paraffine sections show typical appearances. A small mass of tissue containing two small colonies was planted in sugar agar, but no growth was obtained.

The third guinea-pig was inoculated after the microöganism had been under cultivation for about five months and was killed on the fourth day. At the seat of inoculation in the abdominal wall some white cheesy masses two to four millimeters in diameter. Attached to the omentum, liver, peritoneum, etc., were rather many cheesy masses most numerous on the omentum and the largest two to three millimeters in diameter. Paraffine sections showed that clubs were already developed in the colonies.

A photograph of a "club"-bearing colony in a nodule in the peritoneal cavity of a fourth guinea-pig is reproduced (Fig. 52).

Another guinea-pig was inoculated with the growth in bouillon that had been heated in a water bath for fifteen minutes at 57° to 60° C. A sugar agar culture from the growth after the heating failed to develop colonies. The result of the experiment showed, however, that the microörganism was still capable of forming clubs in the tissue, for at the autopsy of the animal sixteen days after inoculation two nodules were found in the omentum, the larger about three millimeters in diameter, and paraffine sections showed colonies with clubs.

A kitten was inoculated subcutaneously and in the peritoneal cavity with this strain. The only effect produced was the formation of a small subcutaneous abscess, which opened and healed spontaneously.

Case XV.— Five guinea-pigs and two rabbits were inoculated in the peritoneal cavity. One guinea-pig and one rabbit that were inoculated last and after the microörganism had been under cultivation about five weeks failed to develop actinomycotic lesions. The most extensive lesions were found in a guinea-pig that was first inoculated after the isolation of the microörganism with a bouillon culture in the third generation from the lesions. The animal was killed after six days. At the point of inoculation were found two nodules one and two millimeters in diameter, and associated with the omentum and liver three confluent resistant masses containing ill-defined nodules three to six millimeters in diameter. Elsewhere in the peritoneal cavity two nodules, two and six millimeters in greatest dimension respectively. Paraffine sections showed granulation tissue with foci of suppuration and actinomyces colonies which did not stain well and without clubs. The animal was killed too soon for the development of clubs in the colonies. In four other animals similar lesions developed, but the lesions were not so well marked. In lesions of only two of these animals was a colony found presenting clubs. Nearly all of the colonies of the microörganism did not stain well and it seemed to be degenerate.

A calf was also inoculated with this strain in the jaw and in the peritoneal cavity. No definite lesions were obtained.

The experiments with this strain of the microörganisms seemed to show quick diminution in its virulence under cultivation.

REVIEW OF THE LITERATURE ON THE BIOLOGY OF THE MICROÖRGANISM OF ACTINOMYCOSIS.

The two most important publications on the subject of the biology of the microörganism of actinomycosis are those of Bostroem[18] and of Wolff and Israel,[87] published in 1890 and 1891 respectively. These are not only the first extensive studies on the biological characters of the microörganism, but they also give widely different descriptions of these biological characters.

The results obtained by these workers have been widely quoted, and have had much to do with the confusion which exists in regard to the biology of the microörganism.

The results reported by Bostroem in relation to this subject may be summarized as follows:

He says that it is of the greatest importance to inoculate as many culture-tubes as possible, for it is impossible to foretell whether the material placed in the tubes contains living microörganisms or not. In one case he found that although eighty-five tubes had been inoculated not a single actinomyces colony developed, some tubes and plates remaining completely sterile and others showing only a few contaminating bacteria. In other cases, in a series of fifty to sixty tubes, four or five actinomyces colonies developed, but never more. If only a few tubes were prepared, it would happen that in one or more colonies would develop, but for the most part the contrary was the case. After gelatin "slant" tubes had been thus inoculated, he proceeded as follows: The upper part of the gelatin "slant" was liquefied, and the material from the lesions and the individual colonies was rubbed up with the melted gelatin by means of a thick platinum wire; then the whole gelatin was liquefied, the rubbed up material distributed throughout it, and plate cultures made. A part of the material was also taken from the gelatin tubes and agar plate cultures made from it. In two cases he observed the growth of the colonies in the gelatin plate itself. The colonies did not grow readily at room temperature and in the depths of the gelatin. This was also true of agar plate cultures. The growth was much better at higher temperatures. In order to hasten the growth he took such granules, or portions of granules, that showed themselves free from putrefactive bacteria in the plates, broke them up between sterilized glass plates, and transferred the disintegrated mass to blood serum or agar slant tubes. This procedure yielded in some cases pure cultures. In other cases it had to be repeated on account of contaminations, and in this way pure cultures were often obtained.

In all he made cultures from eleven cases of actinomycosis of the jaw in cattle, and from these about seven hundred culture tubes were inoculated. From seven cases he obtained cultures of the microörganism, but in all only twelve single separate growths or colonies were found among the seven hundred culture-tubes. This small number of individual growths or colonies is explained by the statement that, as a rule, when in one tube of the series the growth of the microorganism was apparent the other tubes were not longer kept under observation. He says that if he had examined these other tubes more carefully, the percentage of positive results would surely have been much larger. Cultures from three cases in man yielded a positive result in two of the cases.

The microörganism obtained from each of the cases apparently belonged to one species.

This microörganism grew best under aërobic conditions on all culture media in the form of masses of branching filaments, and by its growth formed dense nodular surface membranes or layers which assumed more or less of a reddish color. In old cultures the surface of the growth became white in color, and this appearance corresponded to the transformation of the superficial filaments of the growth into rods and round coccus-like bodies. These coccus-like bodies he regarded as of the nature of spores. The microörganism grew at room temperature and on all culture media, and even on sterilized water.

His observations of the intimate association of the microorganism in the lesions with fragments of grains and similar foreign bodies furnished good evidence in favor of the idea that the specific microörganism existed in the outer world on grains and similar objects and that it was carried into the tissues upon such foreign bodies.

This idea has received strong confirmation from the fact that a considerable group of microörganisms, of which Bostroem's is now known to be a typical example, have been shown by various workers to be widely distributed on grains, grasses, and in the outer world generally. The characteristics of the members of this group have been summarized by Lachner-Sandoval,[38] Foulerton,[75] and Neukirch,[76] who give references to the literature. They are truly branching filamentous microörganisms growing on culture media aërobically in dense masses at the room temperature as well as in the incubator, and having as a marked characteristic the transformation of their homogeneous non-septate filaments into chains of spherical bodies easily separable from one another and constituting reproductive elements of the nature of spores. Some members of this group undoubtedly cause suppurative processes, cases of which have been described by Nocard,[108] Eppinger,[39] Dessy,[40] Aoyma and Miyamoto,[41] MacCallum,[42] Birt and Leishman,[43] Trolldeiner,[44] Horst,[45] Tuttle,[46] McDonald,[47] Schabad,[48] Stokes,[49] and others, but in these cases they do not occur in the lesions in characteristic compact colonies like the microörganism of actinomycosis. Their occurrence in such suppurative processes has also lent weight to the widely prevalent belief, based on the work of Bostroem and a few others, that actinomycosis is due to infection with microörganisms of this group.

In accordance with this belief the generic term Actinomyces given to the microörganism of actinomycosis by Bollinger[4] and Harz has been often used for this group of microörganisms. I do not think that this generic name should be so used, because, as I hope to show in this paper, the microörganism of typical actinomycosis differs widely from the members of this group in its biological characters and because the use of the generic term Actinomyces for them logically leads to giving the name actinomycosis to those cases of suppuration due to infection with certain members of the group.

I think that the generic term Actinomyces should be restricted to microörganisms with the biological characters described in this paper, and that another generic name should be used for the group just referred to, which should constitute a separate genus.

To members of this group the generic names Streptothrix, Nocardia, Cladothrix, and Oospora already have been given by various writers. Of these, in accordance with well-recognized principles of nomenclature, "Nocardia"[50] is the only one that is tenable for the group, if it be made into a separate genus, because the other names have been previously used for plant genera to which these microörganisms clearly do not belong, and they are therefore untenable.

Against the status of the term "Nocardia" as a generic name for these microörganisms, it may be urged that its original definition was faulty, chiefly in that the branching of the filaments was described as false, but this objection has no weight in view of the fact that Blanchard[57] has published an accurate description of a number of species of this group and adopted "Nocardia" as the generic name.

In what follows I shall use the term "Nocardia" in the sense above indicated.

A careful examination of Bostroem's work does not convince me that the microörganism he obtained in his cultures was identical with the characteristic microörganism of actinomycosis.

Bostroem's principal arguments in support of the identity of the microörganism in the lesions and in his cultures are:

1. That he isolated the microörganism from a large proportion of the cases.

2. The agreement of the morphological and biological characters of the microörganism in the cultures with the microörganism in the lesions. This was chiefly seen in the morphology of the filaments, in their arrangement in young colonies in bouillon, and in the finding of filaments transferred into structures essentially like the characteristic "clubs" in old blood serum and gelatin cultures.

The objections to Bostroem's arguments may be formulated as follows:

He found the microörganism in only a very small proportion of his cultures and in no larger proportion than it would be possible for the microörganism he describes to have appeared as a contamination. In view of the rapidity and luxuriance of growth shown by the microörganism in cultures, it would seem that it should have been found in a far larger proportion of the cultures if it were of etiological significance.

This objection is not satisfactorily answered by his statement that a more careful examination of his culture-tubes would have given a larger percentage of positive cultures, for this is nothing more than an expression of his belief; nor is it satisfactorily answered by the assumption that most of the material used for the inoculation of the tubes did not contain the microörganism in a condition capable of growth in the cultures, for it seems improbable that a microörganism, capable of such luxuriant growth in all culture media in the first generations from the tissues, should exist in the tissues with such an overwhelming proportion of its individual representatives either dead or so lacking in adaptation to saprophitic growth as the culture results would indicate.

To the second argument it may be objected that the agreement in morphological and biological characters between the microörganism of the cultures and the microörganism of the lesions is not convincing because Bostroem did not reproduce in his cultures characteristic colonies with peripheral clubs. Anything short of this is not convincing of the identity of the two organisms.

Another objection is that Bostroem failed to show any characteristic pathogenic action upon animals for his microörganism and failed to reproduce by the inoculation of animals even microscopical lesions like actinomycosis. In anticipation of this objection he calls attention to the fact that pathogenic action of his microörganism upon animals should not be expected because inoculation experiments with material from actinomycotic lesions have, in his opinion, never been successful in reproducing the disease.

In brief, I do not accept Bostroem's work on the cultural peculiarities of the microörganism of actinomycosis as convincing, and in the light of my own experience with the subject I am of the opinion that he worked with contaminating microörganisms or secondary invaders of the lesions.

The publications of Gasperini[25, 5] have had great influence in establishing Bostroem's idea that the microörganism of actinomycosis is widely distributed in nature.

It appears from an analysis of his papers, in which his experiments with actinomycotic material are published, that he experimented in all with twenty-two or twenty-three cases of bovine actinomycosis, one of the cases being of a doubtful character. From five of these cases he claims to have obtained cultures of at least two species of Nocardia, or Actinomyces, as he calls them. He reports culture experiments with twenty-two of the twenty-three cases, and obtained a growth of what he considered to be the infecting microörganism from only two of them directly; the cultures from the three other cases were obtained only from experimental animals that had been inoculated with material from lesions.

Gasperini[51] also worked with cultures said to have been derived from actinomycotic lesions at the hands of several other workers. One of these cultures he states came from the stock isolated and described by Dessy.[40] This was not a case of actinomycosis according to the definition given in this paper, but was a case of infection with Nocardia. It is worthy of note, however, that Gasperini claims to have produced with this culture, by inoculation of the jaw of a calf, a lesion in which the microörganism grew in the form characteristic of actinomycosis. This is apparently the only instance in which Gasperini obtained, by an inoculation experiment, a result which could be regarded as of the nature of an experimental actinomycosis.

Gasperini's conclusions from his study of the subject are that a number of different species of Nocardia or Actinomyces, as he calls them, are concerned in the production of the disease actinomycosis.

I do not accept the culture work of Gasperini essentially for the same reasons that I do not accept the work of Bostroem.

A few other writers also report the cultivation of Nocardia from actinomycotic lesions:

Karg[52] in one case in man cultivated an organism which he regarded as identical with that of Bostroem.

Doria[53] describes a Nocardia that he cultivated from a bovine case.

Paltauf, according to Liebman,[54] confirmed the culture results of Bostroem.

Sanfelice[55] in two papers dealing with bovine actinomycosis states that he obtained cultures of Streptothrices more or less closely related to species described by Gasperini and Doria.

Berestneff[56] claims to have cultivated from a human case the microörganism nearly related to a Nocardia described by Gasperini.

The results obtained by Wolff and Israel are very different from those recorded by Bostroem, Gasperini, and others above referred to. From two cases of actinomycosis in man, Wolff and Israel[57] report that they cultivated a microörganism with the following characters:

It grew best under anaërobic conditions and did not grow at room temperature. Its growth was much less luxuriant than Bostroem's microörganism. On the surface of anaërobic agar slant cultures on the third, fourth, and fifth day numerous minute isolated dew-drop-like colonies appeared, the largest pin head in size. These gradually became larger and formed ball-like, irregularly rounded elevated nodules varying in size up to that of a millet seed, exceptionally attaining the size of a lentil or larger. As a rule the colonies did not become confluent, and an apparently homogeneous layer of growth was seen to be made up of separate nodules if examined with a lens. In some instances the colonies presented a prominent center with a lobulated margin and appeared as rosettes. A characteristic of the colonies was that they sent into the agar root-like projections. In aërobic agar slant cultures no growth or a slow and very feeble growth was obtained. In stab cultures the growth was sometimes limited to the lower portion of the line of inoculation or was more vigorous there. In bouillon, after three to five days, growth appeared as small white flakes, partly floating and partly collected at the bottom of the tube. Growth occurred in bouillon under aërobic conditions, but was better under anaërobic conditions. The microörganism in smear preparations from agar cultures appeared chiefly as short homogeneous, usually straight, but also comma-like or bowed rods, whose length and breadth varied. In many cultures short clump rods predominated, and in others longer, thicker, or thinner individuals were more numerous. The ends of the rods often showed olive or ball-like swellings. In egg cultures growth occurred in the form of white opaque granules, the largest about the size of a pin head. Microscopically the growth was characterized by the development of long filamentous forms forming a network. The longer filaments were arranged more or less radially, were straight or wavy or spiral and sometimes branched. Cultures on potato or in milk are not mentioned. Some twenty guinea-pigs and rabbits were inoculated, most of them in the peritoneal cavity with pieces of agar culture. Eighteen animals were killed after four to seventeen weeks, and four were still alive seven to nine months after the inoculation. Seventeen rabbits and one guinea-pig showed at the autopsy tumor growths mostly in the peritoneal cavity and in one instance in the spleen. In the four animals still living tumors were to be felt in the abdominal wall. The tumors in the peritoneal cavity were millet seed to plum size, and were situated partly on the abdominal wall and partly on the intestines, the omentum, the mesentery, and in the liver or in adhesions. Frequently small millet-seed-sized tumors were situated in the neighborhood of the larger tumors. While the surface of the smaller tumors was always smooth, the surface of the larger tumors showed small hemispherical prominences, giving them the appearance of conglomerates of smaller tumors. On section the larger tumors presented a tough capsule from which anastomosing septa extended inward enclosing cheesy masses. Microscopical examination of the tumors showed in all cases but one the presence of typical actinomyces colonies, in most cases with typical "clubs." The general histological appearance of the tumors was like that of actinomycotic tissue.

Wolff[58] in a later paper reports that an animal inoculated in the peritoneal cavity with a culture of the same organism had lived a year and a half. At the autopsy several tumors were found in the peritoneal cavity, and in the liver a large typical tumor in which were many colonies which by microscopical examination were shown to be typical club-bearing actinomyces colonies.

A study of the paper of Wolff and Israel, and especially of the many photo-micrographs that accompany it, leaves little doubt that they worked with microörganisms of the same species as the one described in this paper. The chief points of difference in our results are that I have not obtained, except in possibly one instance, the growth of the microorganism in the long filaments in eggs as they did, and that their microörganisms seemed to produce more extensive lesions in experimental animals than do mine. This difference in our results as regard animal inoculations may be explained on the ground that the portions of agar placed in the peritoneal cavity along with the microörganism may have contributed considerably to increasing the size of the nodular lesions by acting as a foreign body. Some of my experiments support this idea.

Concerning the large number of other published reports bearing on the subject of the biology of the microörganism of actinomycosis, it seems sufficient only to enumerate the names of the writers with such remarks as seem appropriate. With the exception of Schukewitsch and of Lignières and Spitz, none of these writers have produced papers that present the thoroughness and abundance of detail that is shown by the work of Wolff and Israel.

The reports of Aschoff,[59] Newjadomsky,[60] Urban,[61] Grillo,[29] Harbitz[31] (5 cases), Bruns,[62] Berestneff,[63] Krause,[64] Levy[65] (5 cases), Sternberg[66] (3 cases), and Hartman[67] all indicate with a fair degree of certainty that they obtained cultures from human cases of microörganisms similar to or identical with those of Wolff and Israel. Among these might be classed the microörganism isolated by Norris and Larkin[109] from a case that may have been acute pulmonary actinomycosis. From bovine cases similar results have been obtained by Grillo, Lignières, and Spitz,[68] and by Schukewitsch.[69] The last mentioned writer isolated an organism similar to that of Wolff and Israel in twenty-two out of twenty-five cases. From actinomycosis in dogs microörganisms of the same characters have been isolated by Lang and Manasse[70] and by Bahr.[35] From an abscess of the jaw of a horse Dean[71] isolated also a similar microörganism.

Some of these writers made inoculation experiments with the cultures, and three of them (Aschoff, Grillo, and Dean) obtained results more or less similar to those obtained by Wolff and Israel.

The culture results obtained by Kitchensky,[72] Affanassiew and Schulz,[73] Eberman,[74] Foulerton,[75] Berestneff[77] (bovine case), although not very satisfactory, indicate that they probably had to do with a microörganism similar to that of Wolff and Israel.

In connection with the work of Affanassiew and Schulz it may be pointed out that the paper by Protopopoff and Hammer,[78] which reports their study of a culture said to be received from Affanassiew, is not instructive for our present purpose.

Concerning the reports of Crookshank,[16] Ziegler,[79] Prutz,[32] and v. Baracz,[34] it may be said that what little cultural characters they describe for the microörganisms with which they worked are not inconsistent with the idea that their microorganisms were closely related to the microörganism of Wolff and Israel.

The papers of Mertens,[80] Tusini,[86] and Vincent[81] contain good internal evidence that the writers worked for some time with cultures of a microörganism not inconsistent with the microörganism of Wolff and Israel, and that their cultures becoming contaminated they thereafter proceeded to continue their work chiefly or exclusively with the contaminating microörganisms. Vincent's paper deals with cultures from a case of " Madura foot," which was presumably actinomycosis.

The reports of Silberschmidt[33] are confusing and his descriptions are limited. He made culture experiments from thirteen human cases and four bovine cases. Some of his microörganisms showed some characters not inconsistent with the microörganism of Wolff and Israel, and some of his cultures showed signs that they were contaminated with bacteria.

Mousselman and Lienaux[20] obtained cultures from a bovine case, Leith[107] and Jurinka[82] from human cases, which were obviously impure. Their descriptions show that they had to do with a microörganism whose properties were not inconsistent with that of Wolff and Israel.

Garten[83] seems, in my opinion, to have worked with a microörganism that was derived from some blood serum that he used to mix with gelatin to make plate cultures.

The papers of Liebman,[54] Van Niessen,[84] Cozzolino,[85] and Doepke[86] seem to indicate very clearly that the authors worked with mixed growth of bacteria or with microörganisms that had contaminated their cultures.

I find nothing of value in the papers of Brault,[87] Hesse,[88] and Schurmäyer.[89]

The paper of Schurmäyer obviously does not deal with a case of actinomycosis.

The reports of the culture experiments of O. Israel,[90] Budjwid,[91] Lanz,[92] Doyen,[93] Roussel,[94] Dor,[23] Dor and Berard,[95] Deléarde,[27] Karg[52] (second case), Abel,[96] Marwedel,[97] Welleminsky[98] are very meagre and are of little value.

The contents of the papers by Jelenewski,[99] Alissow and Skworzow[100] and of Kozerski[101] are known to me only by abstracts which do not indicate that they are of importance in the present analysis.

Mandereau[102] is said to have obtained cultures, but his paper apparently never was printed and the abstract gives no details of his cultures.

The work of Berestneff[103] is of interest because this writer believes that true actinomycosis is due to Nocardia infection in conformity with the observations of Bostroem, Gasperini, and others, notwithstanding none of his own culture experiments with typical actinomycosis support this view. In this paper he reports five cases of what he calls pseudo-actinomycosis. Four of these were apparently anatomically and histologically like cases of actinomycosis, and one of them, a bovine case, has already been referred to. The fifth case was a suppurative process involving the lung, in which masses of bacteria were present and obviously had nothing to do with actinomycosis. From the four undoubted cases of actinomycosis he made cultures, and because he did not succeed in isolating a Nocardia from any of them he regards them as cases of pseudo-actinomycosis. From only one of the cases, which was the bovine case already referred to in this analysis, does it appear that he obtained a pure culture, and the microörganism cultivated was not inconsistent in its characters with that of Wolff and Israel. Cultures from the three remaining cases seem to be more or less contaminated with bacteria, yet two of them show some indications that he had to do with a microörganism similar to that described by Wolff and Israel.

Lignières and Spitz[104] have published some remarkable observations which have a direct bearing upon the subject under discussion. From cases (number not stated) of a disease in cattle that they call "actinobacillose," which apparently differs in no respect from actinomycosis, except that the granules do not contain Gram-staining filaments, they have cultivated a small bacillus decolorizing by Gram's method and growing well, but not very characteristically, on all the usual culture media. Cattle inoculated with cultures of this bacillus developed lesions like those of the disease in which were found the characteristic club-bearing granules without filaments, and the disease is said to have been exactly reproduced by inoculation. These facts are supported in their paper by details of a large number of observations and experiments, and the remarkable evolution of masses of the small bacilli into the characteristic actinomycotic granule in the inoculated animal is objectively traced and described.

Although these observations were confirmed without reserve by Nocard,[105] I think that further confirmation is desirable. The possibility suggests itself that some of the club-bearing granules in their experimental lesions may have been carried over from the original lesion with the culture material. If it were not for the results obtained in inoculated animals the observations might be explained on the ground that they worked with one of the many contaminating bacteria which are apparently often intimately associated with the granules of actinomycosis, and that the disease studied was actinomycosis in which the granules examined had lost their content of filaments and were obsolete or dead. Such granules must be familiar to all who have worked much with bovine actinomycosis.

GENERAL REMARKS AND CONCLUSIONS.

Branching filamentous microörganisms have been isolated in pure culture from thirteen (13) cases of actinomycosis in man and from two (2) cases in cattle. These microörganisms seem to be all of one species, for the differences among the various strains are no greater than among various strains of tubercle or diphtheria bacilli.

This microörganism grows well only in agar and bouillon cultures and in the incubator; in the other usual culture media and at room temperature it grows only very little or not at all. It is essentially an anaërobe. It does not form spore-like reproductive elements. In cultures its colonies are similar in character to colonies of the microörganism in the lesions of actinomycosis. If colonies of the microörganism are immersed in animal fluids, such as blood serum and serous pleuritic fluid, the filaments of the colonies in immediate contact with the fluid may, under certain unknown conditions, become invested with a layer of hyaline eosin-staining material of varying thickness, and the filament may then disappear. Thus structures are produced that seem to be identical with the characteristic "clubs" of actinomyces colonies in the lesions.

Inoculation experiments on animals were made with the cultures of the microörganism from thirteen cases including the two bovine cases. All of these strains were found to be capable of forming the characteristic "club"-bearing colonies in the tissues of the experimental animals. These colonies were either enclosed in small nodules of connective tissue or were contained in suppurative foci within nodular tumors made up of connective tissue in varying stages of development. With the cultures from most of the cases nodular lesions identical in histological character with those of actinomycosis were produced in inoculated animals and with some of the cultures relatively extensive lesions, considering the size of animal. The most extensive lesions showed little progressive tendency, and in only a very few instances did multiplication of the microörganism in the body of the inoculated animal seem probable. In view of the negative or ambiguous results of those who have inoculated healthy animals with actinomyces directly from the lesions, it would seem that the results of the inoculation of animals with the cultures described in this paper afford as much proof as can be expected from such experiments that the microörganism in the cultures was identical with the microörganism in the original lesions.

From my own observations and from a study of the literature I am of the opinion that but one species of microörganism is the characteristic infectious agent in typical actinomycosis, and that is one with the properties and characters herein described. This microörganism should retain the generic and specific name of *Actinomyces bovis*, given it by Bollinger[4] and Harz. De Toni and Trevisan[50] consider the generic name Actinomyces untenable, because the generic name Actinomyce was given by Meyen,[106] in 1827, to a fungus described by him (Actinomyce Horkelii). Inasmuch as this generic term of Meyen has not received recognition as the tenable name of a genus in the literature of the fungi, the view held by De Toni and Trevisan seems to me to be based on an unreasonably strict interpretation of the principles of botanical nomenclature.

Between Actinomyces from the human and bovine cases I have found no difference which seems to me to be sufficient to justify their classification as separate species.

I do not accept the prevalent belief, based on the work of Bostroem, Gasperini, and others, that the specific infectious agent of actinomycosis is to be found among certain branching microörganisms, widely disseminated in the outer world, which differ profoundly from Actinomyces bovis in having spore-like reproductive elements. I think that these should be grouped together as a separate genus with the name of Nocardia, and that those cases of undoubted infection by them should be called nocardiosis and not actinomycosis. The term actinomycosis should be used only for those inflammatory processes the lesions of which contain the characteristic granules or "drusen." That a Nocardia ever forms these characteristic structures in lesions produced by it in man or cattle has not been convincingly shown.

Because the microörganism here described does not grow well on all the ordinary culture media and practically not at all at room temperature, I do not believe that it has its usual habitat outside of the body. It seems to me very probable that Actinomyces bovis is a normal inhabitant of the secretions of the buccal cavity and of the gastro-intestinal tract, both of man and animals, but I have no proof of this to offer at the present time. In these secretions it should not exist in the characteristic forms seen in the lesions, but it probably will be found in the form of fragmented filaments growing in company with bacteria, and not now differentiated from them. I believe that the part played by foreign bodies so frequently found in actinomycotic lesions is not that of the carrier of the microörganism into the tissues from without, but that the foreign body, by its traumatic and irritative effect furnishes a nidus in the tissues for Actinomyces which enters therein with the secretions from the buccal cavity and gastro-intestinal tract, develops into characteristic colonies, and produces lesions which we call actinomycosis.

Concerning the clubs of the Actinomyces colony I may state that I am unable to decide whether they are an essential product of the microörganism itself, that is, a kind of product analogous to capsule formation among the bacteria, or a deposit upon the microörganism from the surrounding tissue and fluids. According to my observations animal fluids seem to be essential for their production.

The chief function of the clubs or of the hyaline envelope surrounding the peripheral filaments of a colony of Actinomyces bovis is, I think, to protect the mass of the colony from the destructive action of the juices and cells of the tissue. It has been well shown by the work of Bostroem and others that the clubs are only formed when there is evidence of resistance on the part of the tissue toward the microörganism. In rapidly spreading cases or disseminated cases of actinomycosis, as in Case I. of this paper, where the resistance of the tissues to the infection is apparently very slight, little or no club formation may occur, and the colonies may consist only of masses of naked filaments.

Concerning the importance of the bacteria which are so frequently found accompanying the specific microörganism in the lesions I can say that in some cases I believe that they play an important part in the extension of the disease.

There is no doubt, however, that some cases of actinomycosis are pure infections with Actinomyces bovis, and I am sure that it alone is capable of acting as the sole infectious agent.

The so-called spores, cocci, and bacilli, described by various writers in the granules or "drusen" of Actinomyces directly from the lesions, are either products of degeneration and disintegration of the filaments of the specific microörganism or are real micrococci and bacilli growing in symbiosis with it.

In consideration of the fact that Actinomyces bovis has never been shown to have a high degree of virulence for experimental animals, it seems desirable to offer some explanation of the progressive character of some of the spontaneous cases. In explanation it may be pointed out that in addition to the very important factor of individual susceptibility or lack of resistance to the infection, the factors of secondary bacterial infection and of continuous reinfection by way of sinuses connecting with the buccal cavity and with the gastro-intestinal canal may be of great importance. That such sinuses are common in actinomycosis is well known, and that repeated reinfections with this specific microörganism, as well as others, could thus easily occur is obvious, if the assumption be true that actinomyces bovis is a regular inhabitant of the buccal cavity and of the gastro-intestinal tract.

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DESCRIPTION OF PLATES.

(*Photographs by Mr. L. S. Brown.*)

PLATE I.

FIG. 1. — A colony in a section of a sugar agar suspension culture, Case V. x 1,500.

FIG. 2. — Gross appearances of sugar agar suspension cultures, Cases I., II., and III.

FIG. 3 — A colony in a section of a sugar agar suspension culture, Case II. x 1,500.

FIG. 4. — A colony in a section of a sugar suspension culture, Case IV. x 750.

FIG. 5. Two colonies in sugar agar culture, Case III. Preparation not stained.

PLATE II.

FIG. 6. — A colony in a section of a sugar agar suspension culture, Case VII. x 750.

FIG. 7. — A colony in a section of a sugar agar suspension culture, Case VIII. x 750

FIG. 8. — A colony in a section of a sugar agar suspension culture, Case XV. x 1,500.

FIG. 9. — A colony in a section of a sugar agar suspension culture, Case VI. x 750.

FIG. 10. — A portion of a disintegrated colony in a sugar agar suspension culture, Case X. x 1,500

FIG. 11. — A colony in a section of a sugar agar suspension culture, Case XIV. x 1,500.

FIG. 12. — Two small colonies and the margin of a larger colony in a sugar agar suspension culture, Case XI.

PLATE III.

FIG. 13. — A colony in a section of a sugar suspension culture, Case XII. x 1,500.

FIG. 14. — "Club" formation in a culture in serous pleuritic fluid, Case VI. Paraffine section. x 1,500.

FIG. 15. — "Club" formation in a culture in human blood serum, Case V. Paraffine section. x 1,500.

FIG. 16. — A colony in a section of a sugar agar suspension culture, Case XIII. x 1,500.

FIGS. 17, 18, and 19. — Smear preparations from bouillon cultures, Cases XIV., III., and XV., respectively. x 1,500.

PLATE IV.

FIGS. 20, 21, 22, 23, 24, and 25. — Smear preparations from bouillon cultures, Cases I., II., IV., V., VI., and VII., respectively. All x 1,500.

PLATE V.

FIGS. 26, 27, 28, 29, and 30. Smear preparations from bouillon cultures, Cases VIII., X., XI., XII., and XIII. All x 1,500.

FIG. 31. — Surface colonies on agar and on coagulated Löffler's blood serum.

PLATE VI.

FIGS. 32, 33, 34, 35, and 37. — "Club" formation in cultures in blood serum or in serous pleuritic fluid, Cases VII., VIII., IV., and XIV. Paraffine sections. x 1,500.

FIG. 36. — Portion of a colony with very long "clubs" in a lesion in the peritoneal cavity of a guinea-pig, Case IV. Paraffine section. x 1,500.

PLATE VII.

FIG. 38. — Section of a nodule in the peritoneal cavity of a guinea-pig. The dark masses are colonies of actinomyces, Case VI. Paraffine section. Very low magnification.

FIG. 39. — A section of a typical actinomycotic lesion involving the liver in a guinea-pig. The colonies of actinomyces are seen lying in abscesses which are invested by connective tissue. The opening at the left is a small dilated bile duct, Case XII. Paraffine section. Low magnification.

PLATE VIII.

FIG. 40. — Appearances of isolated colonies on the surface of agar slant cultures. The microörganisms are from four different cases.

FIG. 41. — Colony of actinomyces with well-developed "clubs" at the periphery in a nodule in the peritoneal cavity of a guinea-pig inoculated with a culture from Case XII. Paraffine section. Low magnification.

FIG. 42. — Large "clubs" in process of degeneration at the margin of a colony of actinomyces in a nodule in the peritoneal cavity of a guinea-pig inoculated with a culture from Case VIII. Paraffine section. x 1,500.

FIG. 43. — A colony of actinomyces in a nodule in the peritoneal cavity of a guinea-pig inoculated with a culture from Case XI. The peripheral "clubs" are shown. Paraffine section. Low magnification.

FIG. 44. — A colony of actinomyces with peripheral "clubs" in a lesion in the peritoneal cavity of a guinea-pig inoculated with a culture from Case VIII. Paraffine section.

FIG. 45. — A typical "club"-bearing colony of actinomyces in a lesion of the peritoneal cavity of a guinea-pig inoculated with a culture from Case IV. Paraffine section. x 325 Aprox.

PLATE IX.

FIG. 46. — A section of the actinomycotic lesions in the tongue of a rabbit inoculated with a culture from Case II. Paraffine section. Low magnification.

FIG. 47. — Smear preparation from plain bouillon culture, Case I., showing the peculiar olive and pear-shaped swellings at the ends of the short

rods. This was a rather old culture, and these swellings were a prominent feature of this strain of actinomyces in such cultures. High magnification.

Fig. 48. — Large "clubs," some with central filaments. At the periphery of a colony of actinomyces in a lesion in a guinea-pig inoculated with a culture from Case VII. Paraffine section. x 1,500.

Fig. 49. — Large "clubs" at the margin of a colony in a nodule in the peritoneal cavity of a guinea-pig inoculated with a culture from Case XIII. Paraffine section. x 1,500.

Fig. 50. — A colony of actinomyces with "clubs" at the periphery in a nodule in the peritoneal cavity of a guinea-pig inoculated with a culture from Case VII. Paraffine section. Low magnification.

Fig. 51. — "Clubs" at the margin of a colony of actinomyces in a lesion in the peritoneal cavity of a rabbit that had been inoculated from a culture from Case I. One of the "clubs" has a remarkable shape. Paraffine section. x 1,500.

Plate X.

Fig. 52. — A colony of actinomyces in a nodule twenty-eight days old in the peritoneal cavity of a guinea-pig inoculated with a culture from Case XIV. (Bovine Case). The "clubs" are well developed and show some indications of stratification. Paraffine section. x 750 Aprox.

Fig. 53. — Long slender "clubs" at the periphery of a colony of actinomyces in a lesion in the peritoneal cavity of a guinea-pig that had been inoculated with a culture from Case III. Paraffine section. x 1,500.

Fig. 54. — "Clubs" at the periphery of a colony of actinomyces in a nodule in the peritoneal cavity of a guinea-pig that had been inoculated with a culture from Case V. Paraffine section. x 1,500.

Fig. 55. — A colony of actinomyces with well-developed peripheral "clubs" in a lesion in the peritoneal cavity of a guinea-pig inoculated with a culture from Case IV. Some of the "clubs" contain stained filaments. Paraffine section. x 750.

Fig. 56. — Colonies of actinomyces with well-developed "clubs" in a lesion in the tongue of a rabbit that had been inoculated with a culture from Case II. Paraffine section. x 750.

Fig. 57. — Portion of the margin of a colony of actinomyces in a lesion in a guinea-pig that had been inoculated with a culture from Case VII. The felt-work of filaments forming the mass of the colony as well as the peripheral "clubs" are shown. The "clubs" are large and their surfaces beset with small spicules or spines, the result of degenerative changes in the substance of the "clubs." Paraffine section. x 1,500.

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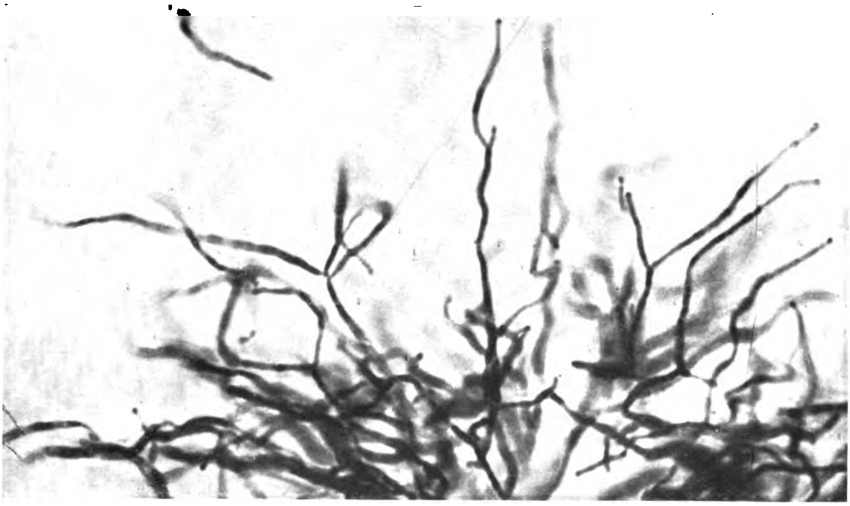

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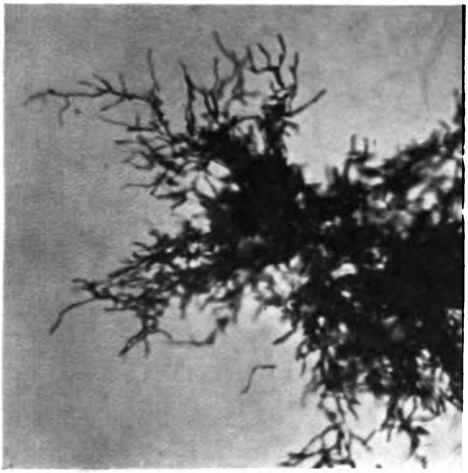

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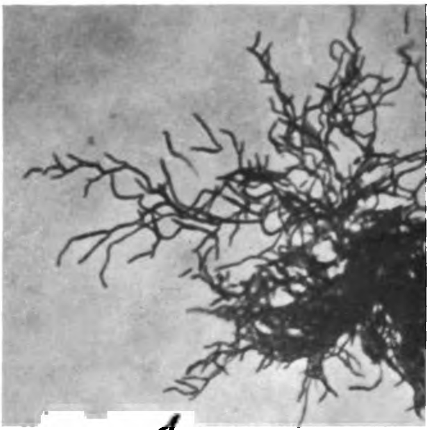

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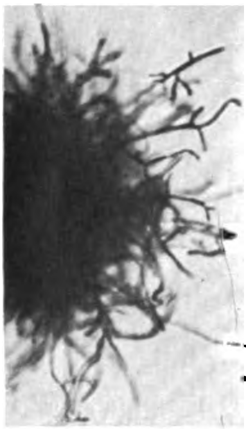

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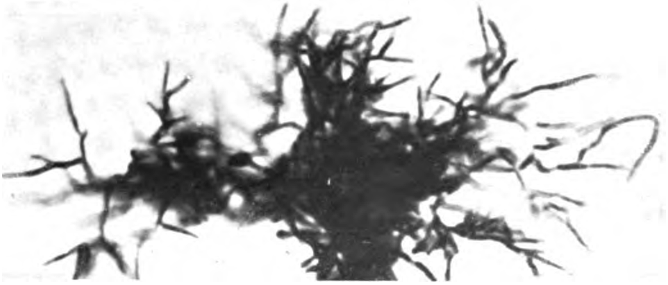

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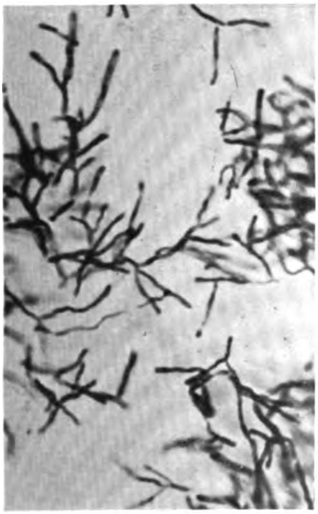

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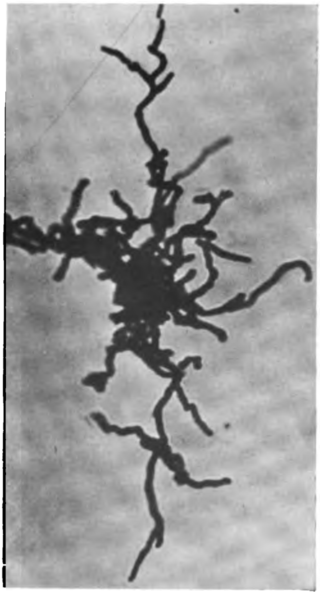

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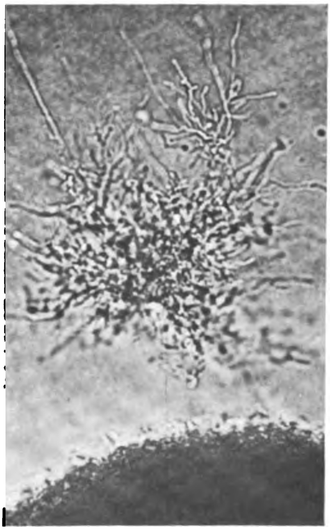

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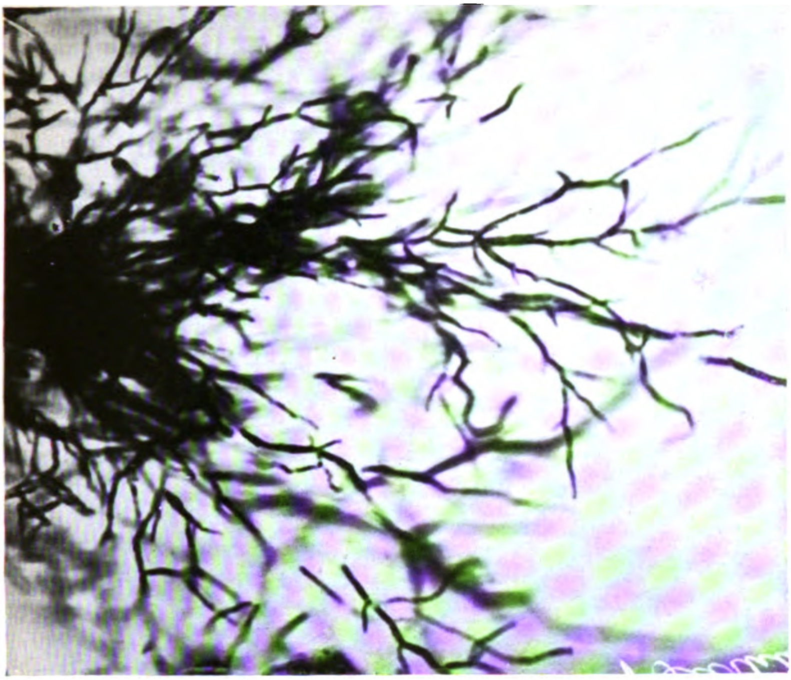

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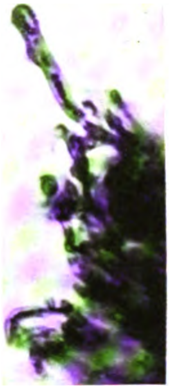

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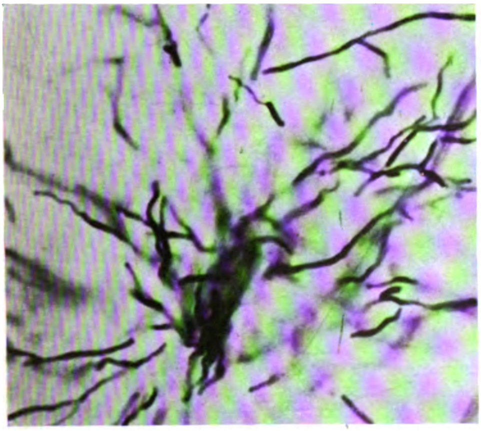

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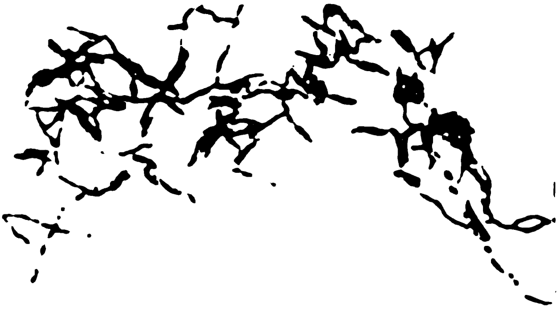

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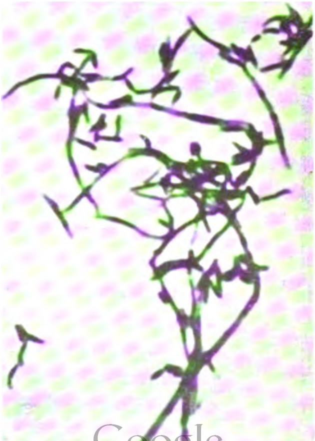

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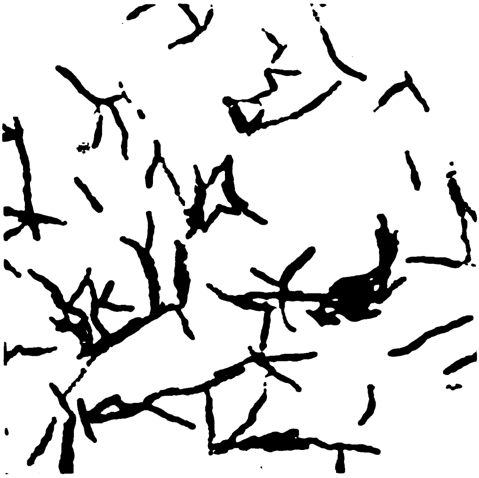

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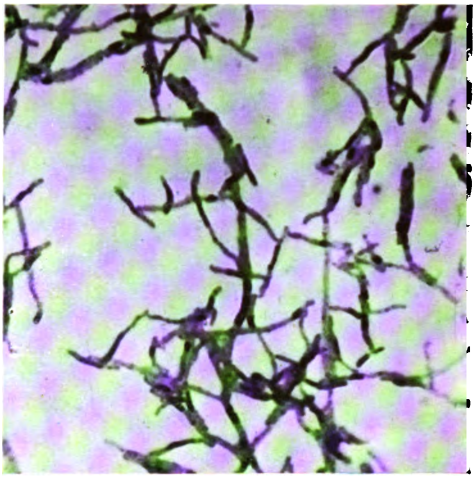

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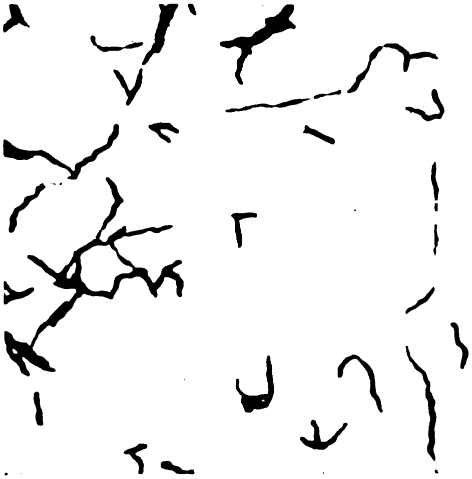

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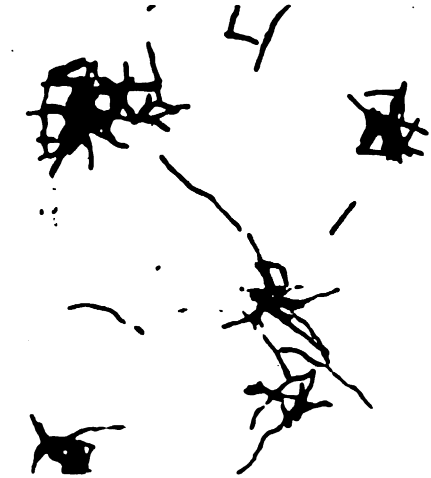

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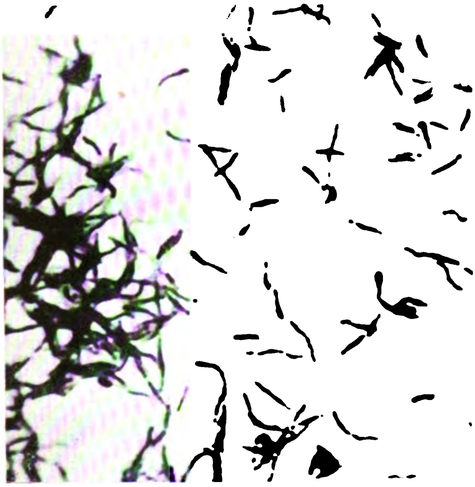

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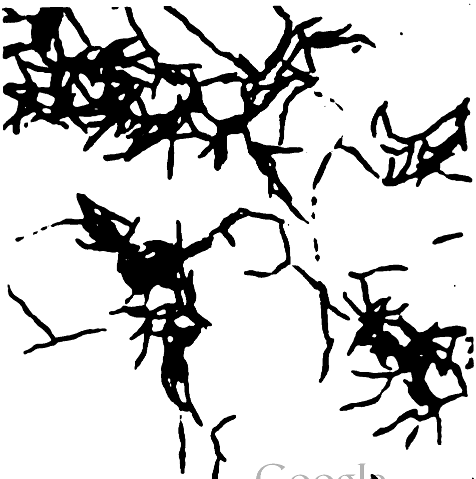

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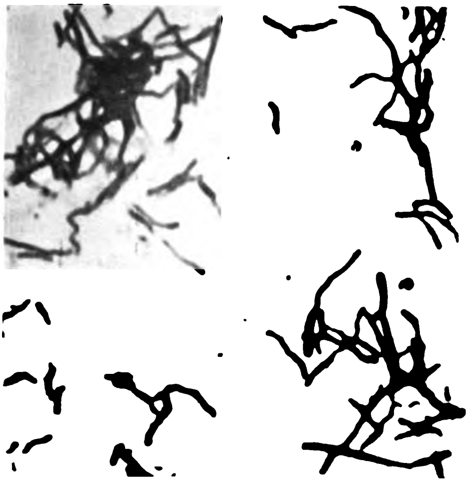

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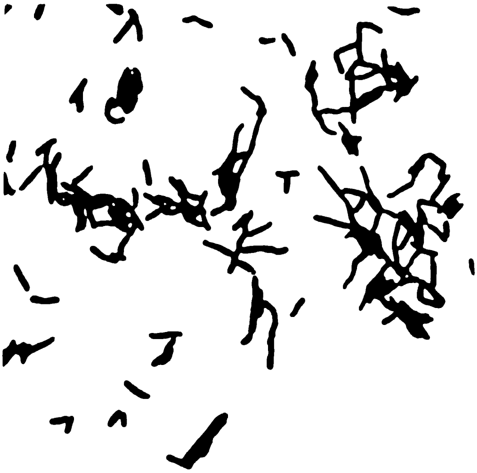

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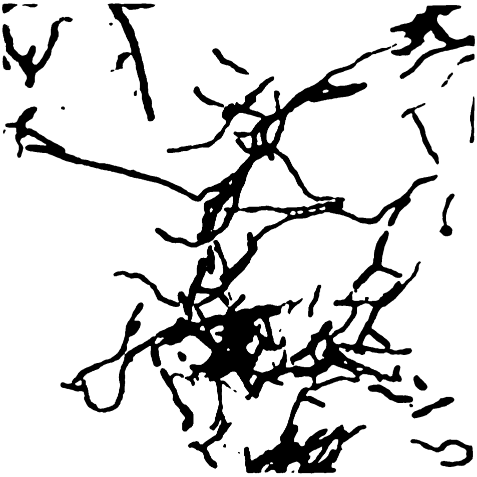

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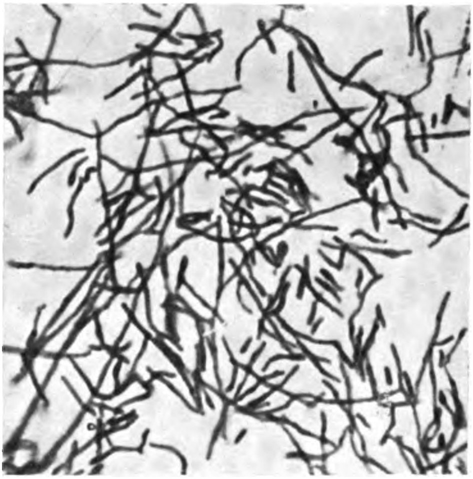

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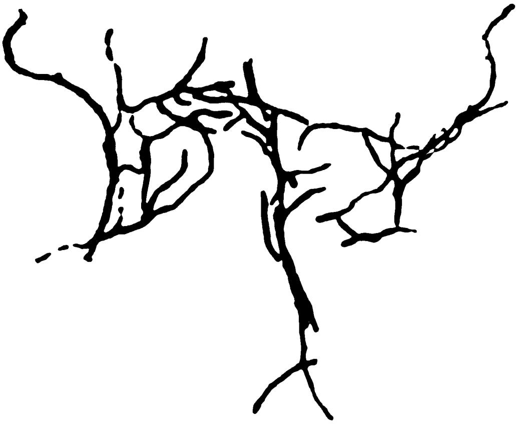

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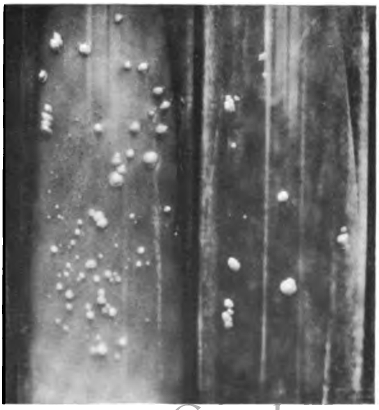

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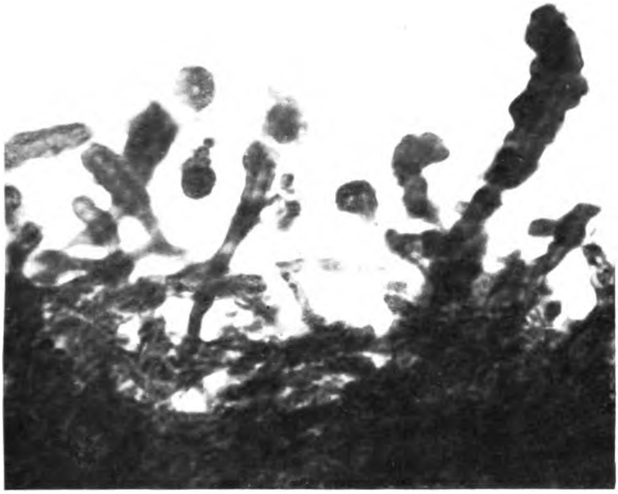

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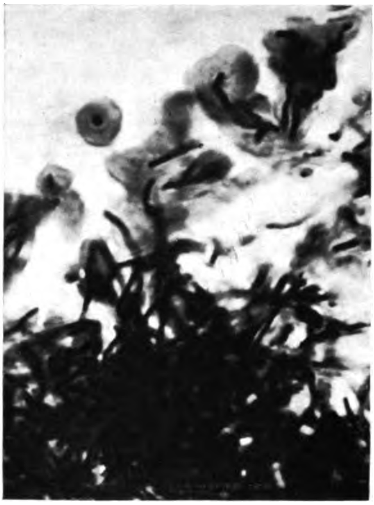

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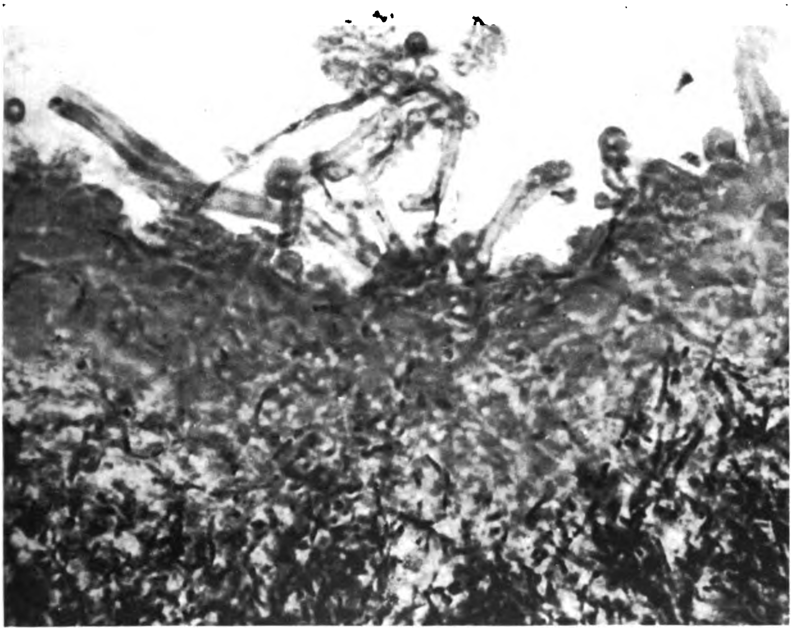

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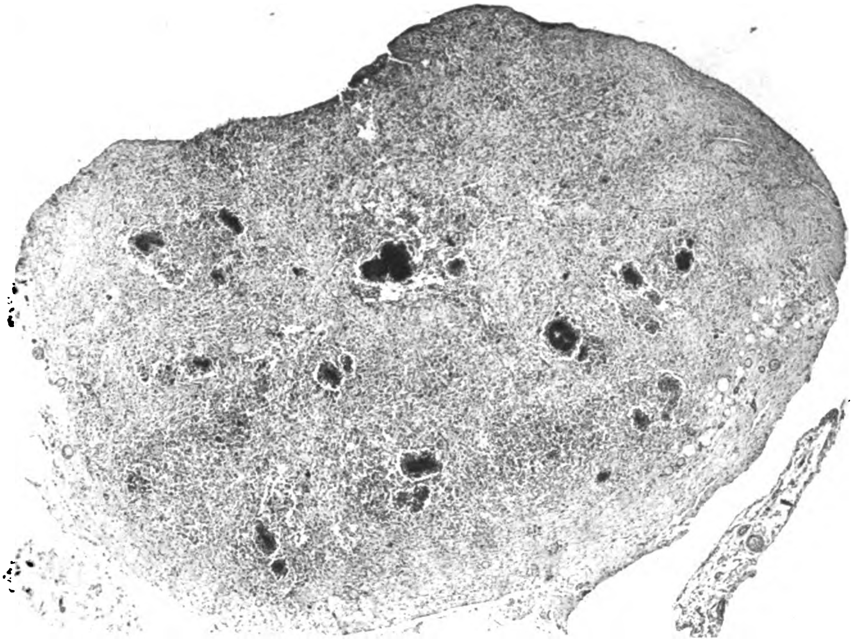

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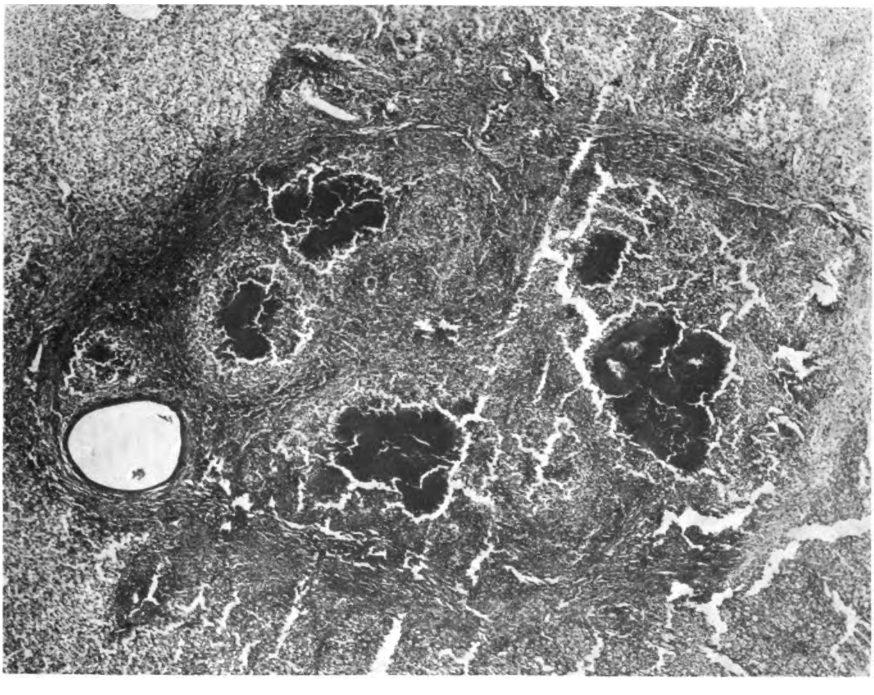

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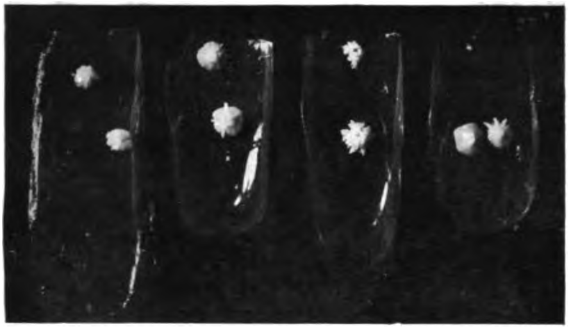

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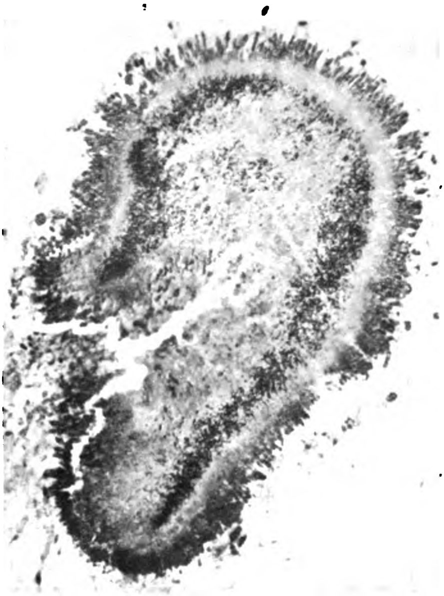

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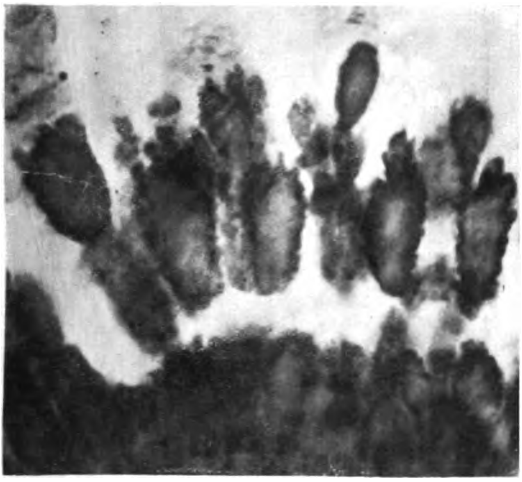

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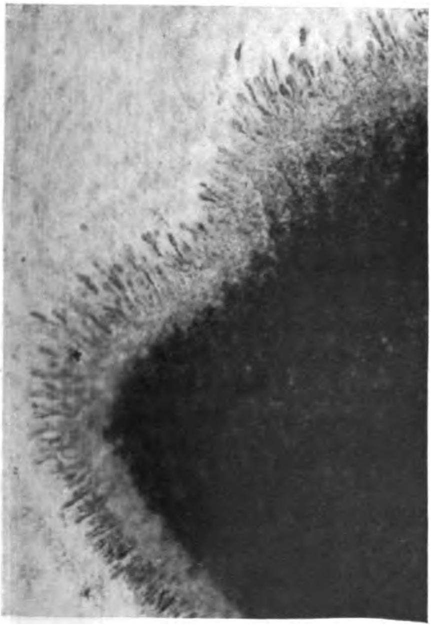

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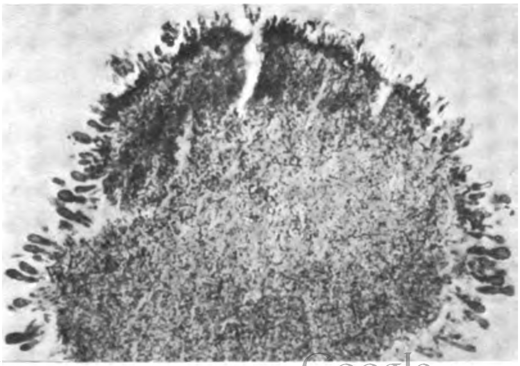

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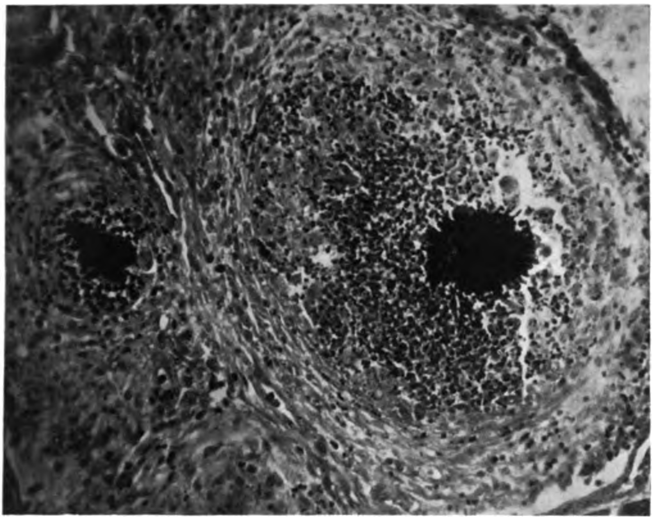

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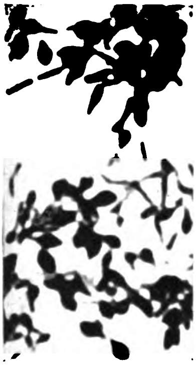

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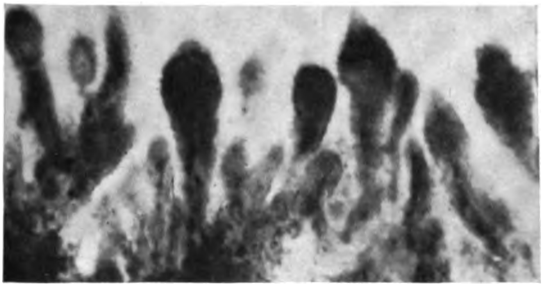

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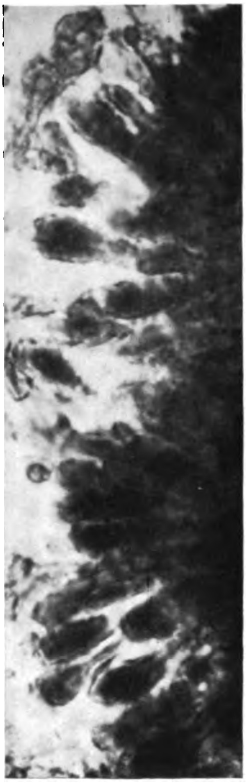

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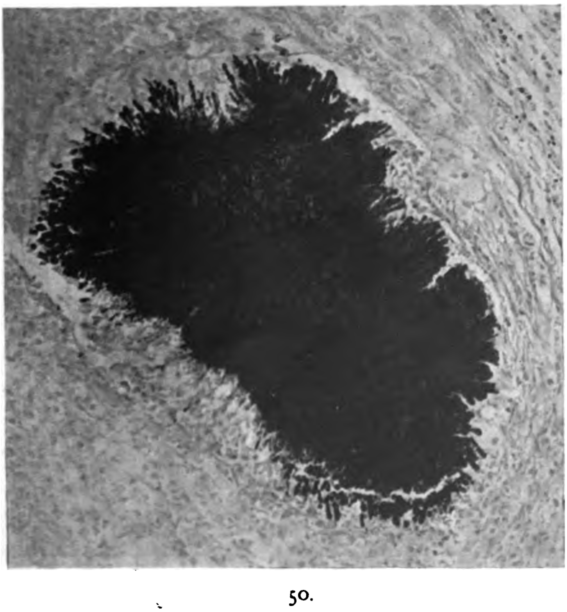

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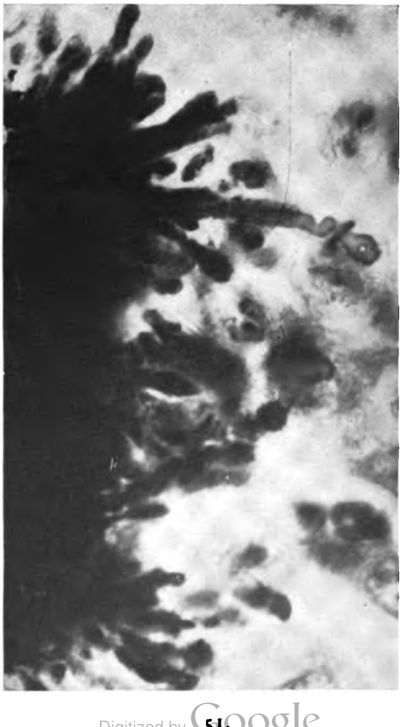

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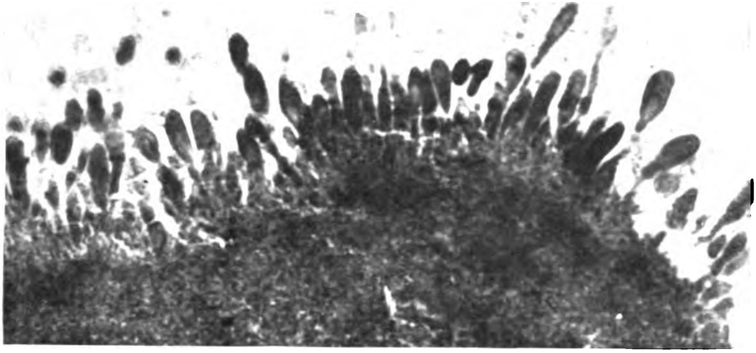

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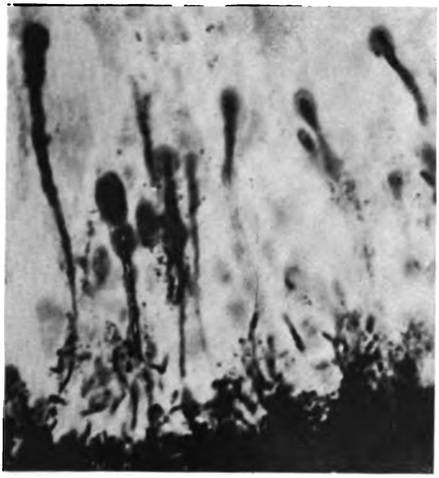

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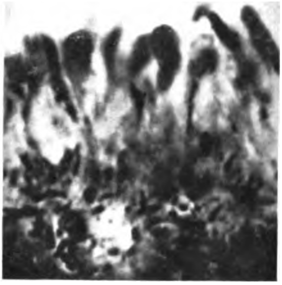

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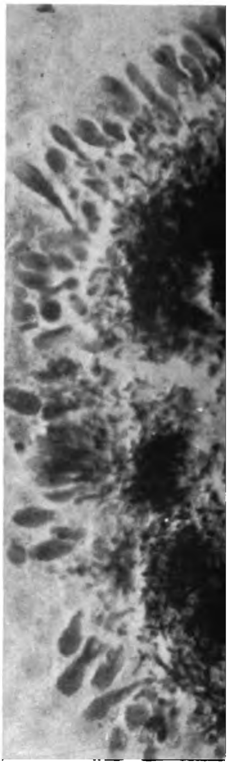

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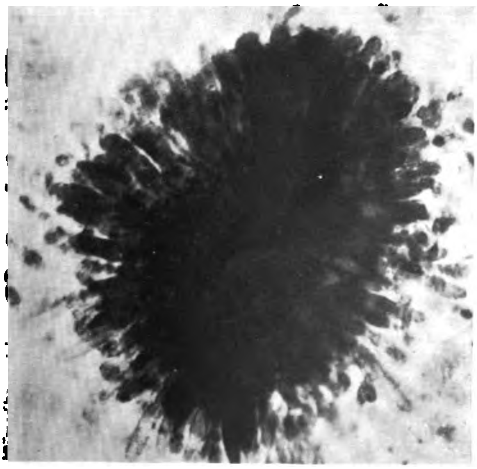

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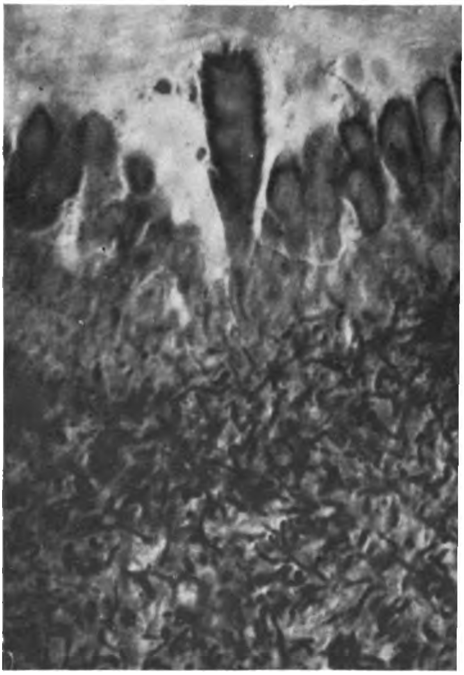

57.

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VOLUME I. FEBRUARY, 1906. NUMBER 2.

INTRAPLEURAL LIPOMA; ACUTE PERICARDITIS; PERICARDIAL EXPLORATION.*

R. H. FITZ, M.D., *of Boston.*

It is well known that in certain individuals, especially the obese, a large quantity of fat tissue may be found beneath the pleura, and it is easily conceived that a lipoma might be developed from this subpleural fat. Cruveilhier,[1] indeed, mentions the occurrence of fatty tumors of the diaphragm which have forced their way through the fibers of this muscle from the subperitoneal fat, at times accumulated behind the ensiform cartilage. The attached peritoneum is stated to form a true hernial pouch ready to receive the abdominal viscera.

A rounded, lobulated, subpleural lipoma somewhat larger than a plover's egg was found by Clark[2] in the right pleural cavity of a woman, aged sixty-five years. Its "base was spread out between the muscle fibers of the diaphragm like the mycelium of a mushroom," and the tumor resembled, "at first sight, a diaphragmatic omental hernia." He calls attention to a normal "outgrowth of fat from the diaphragm situated on the right side anteriorly close to the reflection of the pericardial pleura on to the diaphragm. This may, in cases of general obesity, become occasionally so increased in amount as almost to assume the appearance of a fatty tumor, but does not, of course, constitute a true tumor, since it is but part of a general physiological process."

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*Also published in the American Journal of the Medical Sciences, November, 1905, Vol. cxxx, p. 785, and in the Transactions of the Association of American Physicians, 1905, Vol. xx, p. 57.

[1] Traité d'anat. path. gén., 1856, tome iii, p. 310.

[2] Transactions of the Pathological Society of London, 1887, Vol. xxxviii, p. 324.

Conner[1] records a somewhat similar observation. He found in an elderly woman, who died of cerebral hemorrhage, a sessile, fatty tumor measuring 4 x 3 centimeters. It was covered by pleura and projected from the diaphragm into the left pleural cavity a little to the left of the apex of the heart. At its base there appeared to be a deficiency in the diaphragm, which was offered as a possible explanation of the origin of the tumor.

The subpleural fat along the intercostal spaces is often abundant, and Rokitansky[2] states that, at times, it projects into the pleural cavity as notable, lobulated masses.

Lancereaux[3] knows of but one well-authenticated instance of a subpleural lipoma. Chiari[4] is stated to have observed in an elderly female a pendulous lipoma of the size of a walnut projecting into the pleural cavity from the seventh left rib.

The subpleural lipoma of the costal wall may become so large as to be of practical importance, as illustrated by the experience of Czerny.[5] This surgeon removed a lipoma of the size and shape of a man's head from below the left shoulder-blade of a male patient, eighteen years old. The tumor was of rapid growth and was found at the operation to be continued into the thorax between the seventh and eighth ribs, which were separated by a gap of the size of a hen's egg. The patient died of septic pleurisy, and the subpleural cavity within the chest, from which the innermost portion of the tumor was removed, contained several sinuses. The growth was considered to have proceeded from the endothoracic fascia beneath the pleura. Several years later a like experience was published by Plettner[6] as having been met by Volkmann in the practice of another surgeon. An elderly woman had a lipoma of the size of a child's head projecting from the left wall of the thorax. At the operation it was found to be prolonged into the chest by a pedicle between the fourth and fifth ribs in the axillary line. The outer portion of the tumor was removed, but the patient died of septic pleurisy and pericarditis due to an ichorous inflammation of the pedicle. At the autopsy the latter was found to be continued into a flattened subpleural lipoma as large as a hen's egg. Gussenbauer[1] examined a female patient, aged twenty-nine years, who had a tumor at the upper border of the left mammary gland. It was of the size of a nut and lay in the second intercostal space between the edge of the sternum and mammillary line, beneath the mammary gland and the pectoral muscles. The latter structures could be moved over the tumor, which could not be displaced from the thoracic wall. Three years later the patient again was seen, the tumor having become enlarged in the meantime, and especially within the previous months. It was regarded as an encapsulated lipoma proceeding from the second intercostal space, on account of its mobility, consistency, lobulated surface and place of fixation. Its matrix was considered to be the subpleural fat tissue, as in the case reported by Czerny, which Gussenbauer also had seen, and in accordance with the previously mentioned statement of Rokitansky concerning the subpleural fat. At the operation a pedicle twice as thick as the finger was extended from the tumor into the chest through the widened second intercostal space. Traction upon the pedicle brought to view a portion of the intrathoracic tumor. The latter was enucleated by the finger from its subpleural attachments and was removed. It was a little smaller than the outer tumor, about the size of a man's fist, and was contained within a subpleural cavity. The entire tumor was twice as large as the fist, and weighed over five hundred grams. The patient recovered.

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[1] Proceedings of the New York Pathological Society, 1897–98, p. 43.

[2] Lehrb. d. path. Anat., 1861, Bd. iii, p. 39.

[3] Traité d'anat. path., 1879–81, tome ii, p. 147.

[4] Gussenbauer, Arch. f. klin. Chir., 1892, Bd. xliii, Festschr. 233.

[5] Wien. med. Woch., 1875, Bd. xxv, p. 166.

[6] Inaug. Diss., Halle, 1889.

The fat tissue of the mediastinum also is known to have served as the place of origin of intrathoracic lipomata which have projected externally from the wall of the chest, and have been submitted to surgical treatment. Cruveilhier[2] states that during an operation for the removal of a lipoma in front of the sternum the surgeon found several prolongations continued from it along the edges of this bone into the anterior mediastinum. Most of these were withdrawn and cut off. The patient died of suppuration of the anterior mediastinum. He mentions[1] also that Morel-Lavallée successfully removed from the sternal region the superficial portion of a lipoma which was continued into the anterior mediastinum by a prolongation which was not disturbed.

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[1] Loc. cit., p. 322.

[2] Loc. cit., p. 315.

Kronlein[2] reports the case of a female infant, aged one year, operated upon by Langenbeck. At the age of six months a small tumor near the right breast was noticed by the parents. It grew rapidly, and at the time of operation formed a lobulated mass extending from the right axillary line to three centimeters beyond the left sternal edge, and from two fingers' breadth below the right clavicle to the xiphoid cartilage. At the left of the tumor there was dulness on percussion, preventing an accurate determination of the outlines of the heart. The apex beat was palpable in the sixth interspace, two centimeters outside the mammillary line. The tumor increased considerably in size in the course of five days, and Langenbeck suggested its probable lipomatous character and congenital origin from the anterior mediastinum with subsequent perforation of the thoracic wall. On exposure of the tumor it was found to be continued into the chest through the third intercostal space, one centimeter from the right sternal edge, by a pedicle as thick as the thumb. The pedicle was cut across at the level of the ribs, and the external tumor removed. The infant died of erysipelas. At the autopsy a rounded lipoma as large as a child's head, and covered with a firm, fibrous capsule, was found completely filling the anterior mediastinum, and continuous with the pedicle above mentioned. It projected two to three centimeters beyond the right sternal edge, and filled almost the entire anterolateral portion of the left thoracic cavity, leaving only a small space below and behind, in which lay the compressed lung and the displaced heart.

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[1] Loc. cit., p. 322.

[2] Arch. f. klin. Chir., 1877, Bd. xxi, Supplement, 157.

The following unique case shows that subpleural lipomata may have a medical as well as a surgical interest. The patient, a fisherman, aged thirty-four years, lean, always well with the exception of a "typhopneumonia," entered the Massachusetts General Hospital Jan. 4, 1905. He had been seized with a severe chill ten days previously, followed by pain across the chest aggravated on deep inspiration. There was a distressing cough, with rusty sputum and considerable dyspnœa. The physical signs indicated consolidation of the left upper lobe.

In the lower left axilla, corresponding to the region of the inferior third of the lower lobe of the lung, there were dulness on percussion and absence of respiratory and vocal sounds. The midaxillary region was occupied by a wedge of normal resonance and respiratory sounds, with its apex in the vicinity of the left nipple. There were dulness, diminished fremitus, and feeble vocal and respiratory sounds in the left back between the angle of the scapula and the spine. Numerous medium, moist rales were heard at the base of the left lung behind. The left border of cardiac dulness was four and three-quarter inches from the median line, and the right border of dulness was at the right sternal edge. The apex beat was audible in the fifth intercostal space four and one-half inches to the left of the median line. The heart sounds were regular, rapid, and distant; the second sound was strong at the apex. Adventitious sounds were not heard. There were 41,200 leucocytes per cubic millimeter and eighty per cent of hemoglobin.

During the subsequent four days the temperature fell from 104° to 101°, near which latter point it persisted. In the same period of time the pulse fell from 145 to 100, near which rate it subsequently remained. The respiration at first was from 50 to 35, but after five days ranged from 25 to 30, until within two days of his death, when it rapidly rose to 45. Death occurred two weeks after entering the hospital.

For a few days he was mildly delirious, the white count remained high, the signs of consolidation persisted, but on the fifth day the failure to improve and the faintness of the heart sounds suggested the possibility of an acute pericarditis.

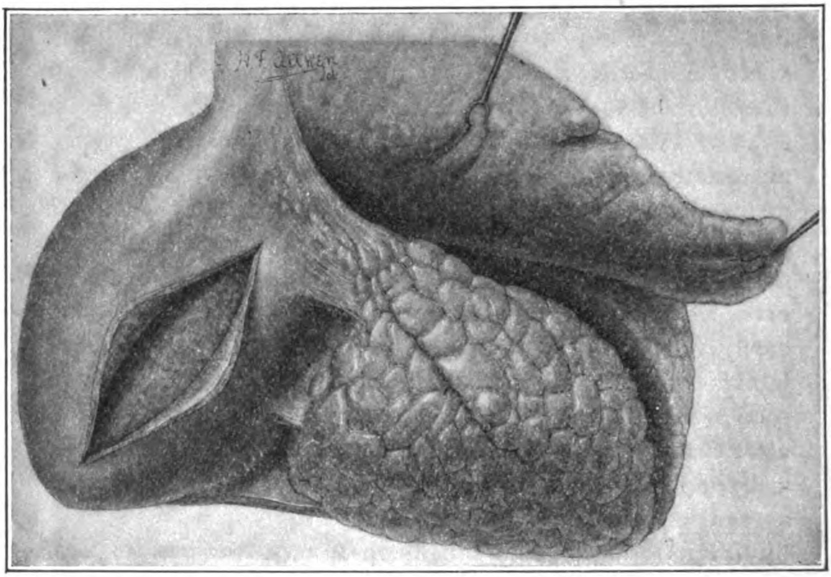
The general condition of the patient then became somewhat better, but the physical signs persisted and the leucocyte count remained high. Attention was constantly directed to the pericardium, as well as to the lungs and pleuræ, in search of an explanation of the persistent elevation of temperature, and the continued leucocytosis.

Ten days after entrance and the twentieth day of the disease it was noted that the signs of consolidation continued in the left lung. The right border of cardiac dulness remained at the right sternal edge, the cardiohepatic angle was obliterated, and the heart sounds were faintly heard. The pulse became paradoxical. Although dulness persisted in the left back between the angle of the scapula and the spinal column, the vocal resonance and fremitus and the respiratory sounds were normal.

On the following day, the twenty-first of the disease, the pericardium was tapped in the fifth interspace near the left border of the sternum, and again in the left fourth interspace some two inches from the sternal edge. Although the cannula entered at least an inch and a half in each place, and the surface of the heart was reached, there was no escape of fluid. Two days later, in consequence of attacks of dyspnœa and cyanosis, although there was no change in the physical examination of the chest, the exploratory trocar and cannula were inserted through the sixth left interspace in the axillary line into the subjacent area of dulness with the thought that pus might be present. The instrument entered readily between two and three inches and the tip was moved about freely. After withdrawal of the trocar no fluid escaped, nor did air enter the cannula. The trocar was reinserted and withdrawn and a second attempt at aspiration was made, but without effect. When the cannula was removed it was found to contain a fragment of soft material suggesting fibrin, but which, on microscopic examination, proved to be fat tissue.

My assistant, Dr. Beals, was asked to explore the pericardial cavity from the left xiphicostal angle after the patient's death, which took place the same day. He withdrew about a pint of creamy pus.

A post-mortem examination was made by Dr. James H. Wright, from whose record the following abstracts are made: "On opening the pericardium a large amount, probably five hundred cubic centimeters, of yellowish opaque fluid gushes forth. . . . Adherent to the inner aspect of the pericardial sac and to the surface of the heart everywhere is a dirty yellowish, finely shaggy or rough fibrinous layer one to three millimeters thick. . . . The epicardial fat over the right ventricle near the pulmonary artery is much larger in amount than normal, forming a layer three or four millimeters thick. . . . Attached to the pericardium on the left side and apparently continuous with the fat tissue of the superior mediastinum is a large mass of fat tissue of about the volume of a new-born child's head, divided by delicate connective tissue septa into larger and smaller lobules. It evidently occupied the inferior and anterior portions of the left pleural cavity, the left lung being behind and above it. The inferior lobe is of about one-third the normal volume. . . . On section it is dark red in color, moist and not obviously atelectatic. The appearance of this lobe of lung suggests rather a hypoplasia than atrophy and atelectasis. The large amount of fat tissue just referred to is more or less adherent by fibrous adhesions to the diaphragm, to the pericardium, to the parietal pleura, and to the inferior lobe of the left lung. Portions of it were left in the body on removal of the thoracic viscera. As far as could be determined the shape of the mass of fat tissue was more or less that of a pear, the small extremity being attached most firmly to the external surface of the pericardial sac along a line extending from the anterior mediastinum in the region of the pulmonary artery (where it seemed to be continuous with the fat tissue of the pericardium) downward on the left side toward the posterior mediastinum. The mass of fat tissue appeared to be covered in places by a thin, shiny layer resembling the pleura. The superior lobe of the left lung is voluminous and extremely resistant to the touch. On section the cut surface is grayish, granular, firm, and when scraped with a knife yields a rather thin, reddish fluid. The pleural surface of the superior lobe is grayish and opaque, not shiny. . . . Fluid of pericardium aspirated post-mortem shows growth of pneumococci by culture. . . . Most of the air cells in the section from the superior lobe of the left lung contain an exudate consisting chiefly of fibrin in dense strands and masses. In a few places there is an outgrowth of fibrous tissue into the air cells, not sufficiently extensive to justify calling the condition organizing pneumonia. The appearances in the section indicate a lobar pneumonia in which resolution has not been thoroughly established."



Intrapleural lipoma proceeding from the fat tissue of the superior mediastinum.

It is evident from the history of the patient and from Dr. Wright's examination that a pneumococcal pericarditis developed without characteristic symptoms or signs in the course of an acute pneumonia of the left upper lobe and that the resolution of the latter was delayed. Owing to the persistent solidification of this lobe and the presence of a large intrapleural lipoma of mediastinal origin the pericardial exudation was not enabled to cause a lateral increase of pericardial dulness. On the contrary, as was made evident by aspiration, the fluid was accumulated behind and below the heart.

The congenital origin of the lipoma is indicated by the accompanying hypoplasia of the lower lobe of the left lung. Its discovery was wholly unexpected, although the physical signs and the result of aspiration would permit a diagnosis in a second case. Its significance to the physician lies in its presence being a satisfactory explanation for an unusual distribution of pericardial exudation, and its localization offers an opportunity of error in the diagnosis of a circumscribed pleuritic exudation.

It is a matter of common knowledge that even considerable quantities of liquid pericardial exudation occasionally escape recognition. Characteristic symptoms may lack and the heart adapt itself to the encumbrance of moderate accumulations of fluid, and, as a rule, the quantity present is small. Pericardial paracentesis, therefore, is of relatively infrequent occurrence. During a period of thirty-four years at the Massachusetts General Hospital there are noted in the index of the records one hundred and fifty cases of acute pericarditis, of which fourteen were tapped; five of these died, four were discharged much relieved, two relieved, and three well. In four cases no fluid was obtained, while in the remaining eight quantities varying from one drachm to one quart were removed. In six cases less than four ounces were obtained.

Since October, 1896, evidence of acute pericarditis has been noted in twelve autopsies. The largest quantity of fluid found was nearly one pint, and in the patient concerned the existence of a pericarditis was not suggested until the day of death. In a second instance a half-pint was present, but in the majority of the cases the quantity of fluid observed was less than five ounces.

The diagnosis of an exudative pericarditis is determined by rational signs indicative of an infectious process and by physical signs calling attention to the seat and extent of the exudation. The rational signs alone are not to be depended upon to direct suspicion to the pericardium, since pericarditis usually is secondary to an inflammatory process elsewhere, for example, in the lung, pleura, or peritoneum, the symptoms of which are likely to mask those proceeding from the pericardium.

Especially significant in the etiology of the cases tapped in the hospital were acute pneumonia and rheumatism, each in four cases, while the pericarditis was regarded as primary in three instances. The diagnosis is comparatively easy when the course of the disease can be traced from the initial pain and friction sound to the gradually increasing area of cardiac dulness of characteristic outline, with fading rub and increasing remoteness of cardiac sounds. It is rendered more difficult when the adherent lungs prevent the lateral distention of the pericardial sac, the adjacent lung is solidified, the pleural cavity contains an exudation or the anterior wall of the heart is united to the parietal pericardium by old or recent adhesions. To these familiar obstacles a new source of difficulty is to be added, viz.: the intrapleural lipoma, especially when it attains the size and position shown in the case here reported, as well as in that of Krönlein-Langenbeck.

The experience above recorded indicates the essentially exploratory nature of pericardial paracentesis and emphasizes the importance of a thorough exploration in doubtful cases. As usually performed, the needle is inserted into the fourth or fifth left intercostal space near the sternal edge or some two inches from it. The failure to obtain fluid at these points in the case here reported led to the assumption that the exudation was largely fibrinous. The absence of an increased area of dulness at the right of the sternum negatived the thought of tapping at Rotch's point in the fifth right interspace, one and one-half inches from the sternum. The positive result of the post-mortem puncture in the left xiphicostal angle makes it obvious that this way into the pericardium should always be favored in cases of suspected exudation, if not in the first instance, certainly when aspiration at other points has proven ineffectual.

Larrey[1] originally recommended this route for pericardial drainage, and gave specific directions for performing the operation. He was led so to do from having successfully drained in this region a stab wound, which gave satisfactory evidence of communicating with the pericardial cavity. Roberts,[2] however, objected to paracentesis in this situation unless the case were exceptional, from the possibility of wounding the diaphragm and liver, and from the difficulty of determining the edge of the ensiform cartilage in fat persons. In two cases in which I have punctured the pericardium in the left xiphicostal angle, although fluid was not obtained, no ill effect followed, and the condition of the patients improved temporarily, at least, after the exploration was made.

From the facts above narrated, and from those reported by F. C. Shattuck[3] and others, an exploratory incision in the xiphicostal region seems advisable in urgent cases when exploratory puncture has afforded no relief. Roberts[4] recommended exploratory incision as far as the pericardium when there was a doubt between a large pericardial exudation and a dilated heart. More recently he states[5] that incision is better than aspiration, even when the affection is not supposed to be purulent. Brentano[6] advocates in all cases pericardial incision with previous costal resection as less dangerous than paracentesis, and Weintraud[7] prefers incision to paracentesis. Although Roberts[8] now is in favor of exploratory aspiration in the upper part of the left xiphoid fossa, he considers that this region does not afford room for incision and drainage. Ogle and Allingham,[9] on the contrary, recommended the plan of reaching the pericardium originally outlined by Larrey, followed by the removal of two inches of the seventh left costal cartilage, if necessary. Latham and Pendlebury[1] reported the successful performance of this operation with a vertical instead of an oblique incision and the removal also of two inches of the sixth costal cartilage, and Pendlebury[2] has operated upon two additional cases, one of which recovered.

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[1] Clin. Chir., 1829, tome ii, p. 303.

[2] Paracentesis of Pericardium, 1880, p. 66.

[3] Transactions of the Association of American Physicians, 1897, Vol. xii, pp. 193, 196.

[4] Annals of Anatomy and Surgery, 1881, Vol. iv, p. 250.

[5] The American Journal of the Medical Sciences, 1897, Vol. cxiv, p. 649.

[6] Deutsch. med. Woch., 1898, Bd. xxxii, p. 507.

[7] Lehrb. d. klin. Untersuch. Meth., 1905, Bd. ii, p. 380.

[8] The American Journal of the Medical Sciences, 1897, Vol. cxiv, p. 652.

[9] Lancet, 1900, Vol. i, p. 693.

Mintz[3] also has successfully drained the pericardium in the region recommended by Larrey.

There is, therefore, no doubt that aspiration through the left xiphicostal space has disclosed pericardial exudation which was not made evident by puncture elsewhere, and that successful drainage has been established through the same region. Consequently this route is to be recommended for exploratory aspiration, incision and drainage, since it gives ample room (by resection of the costal cartilage, if necessary), is free from risk to the pleura and peritoneum, and enables injury of the internal mammary vessels to be avoided or controlled. In critical cases when aspiration causes no outflow of fluid and the tip of the instrument can be moved about within the pericardium exploratory incision should speedily follow.

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[1] Ibid., 1903, Vol. i, p. 798.

[2] Ibid., 1904, Vol. ii, p. 1145.

[3] Centralbl. f. Chir., 1904, Bd. xxxi, p. 59.

THREE CASES OF TUMOR OF THE SPINAL CORD OPERATED ON WITH GOOD RESULT.[*]

J. Collins Warren, M.D., *of Boston, Mass.*

The satisfactory result obtained by operation in each of these three cases makes a brief report of their symptoms and subsequent histories of some interest. In two, extramedullary and easily enucleable tumors were found, and the symptoms of pressure on the cord have been relieved. In the third case, in which the symptoms were known to be caused by an extensive intramedullary growth, a palliative operation gave complete relief to a most distressing condition and seemed to arrest a progressing paralysis.

Case I., in which operation was done just seven years ago, and Case III., in which operation was done seven and a half years ago, were reported by James J. Putnam and myself in the American Journal of Medical Science in October, 1899, but as the subsequent histories of both have been followed to the present time, a further statement seems warrantable.

Case I. — The patient was a lady of fifty at the time of operation. The first distinct symptom of her trouble had occurred about a year and three months previously, in the onset of severe attacks of pain, which gradually increased in frequency. This pain was most severe in the region of the lower left ribs, the left side of the abdomen and groin.

The wide extent of the pain is interesting, for it was not confined, as is sometimes the case, to a definite nerve area. The next striking symptom appeared about six months later, when the patient began to have difficulty in walking, due to an inability to lift the left foot; and from that time on the pain increased in severity, until any movement of the body caused great distress and walking became impossible. At the time she was referred by Dr. Putnam for operation she was in a helpless condition, unable to stand, and in constant pain. The deep reflexes were much exaggerated, there was impairment of sensibility in the area of the lumbar nerves, and the bladder was only partially under control. Operation was done in June, 1898, and by laminectomy the dura in the region of the eighth, ninth, and tenth dorsal vertebras was exposed. The dura was incised at the level of the ninth dorsal vertebra, where a swelling was

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[*] Reprinted from American Medicine, Vol. x, No. 9, p. 349, Aug. 26, 1905.

noticeable, and from beneath a fibroma was removed, which, lying in the meshes of the pia, had offered firm pressure on the left and posterior surfaces of the cord. The tumor was about the size and shape of an olive.

The recovery in this case has been practically complete, the history having been one of slow but progressive improvement. She is in fine health, and the only suggestion of her old trouble is in an involuntary twitching and drawing up of the left foot, which is most noticeable when she is fatigued. Her gait is normal, but when fatigued she still assumes a stooping position. There is no undue excitability of the deep reflexes, motion is unrestricted, and sensibility is normal.

However, for less than a year has she been completely free from the pain which persisted so long after operation. That has been a striking feature of the convalescence. For the first few months, with the return of voluntary motion in the legs, there was associated most distressing cramps of the muscles. Up to within two years, she has been unable to walk more than very short distances without great fatigue and pain.

It seems in this case as if the restoration of function of the injured cord, though now practically complete, had been very slowly established, and in this respect it offers marked contrast to the following case:

Case II. — This patient, a married woman of twenty-seven, entered the Massachusetts General Hospital on Dec. 2, 1904, having been sent by Dr. Putnam for operation. Her history was briefly as follows: For about two years she had suffered from pain in the left side, over the lower ribs and upper abdomen, varying at times in intensity and location, and strongly suggestive of nerve-root irritation.

Six months before she first noticed numbness of the toes of both feet, and for three months there had been increasing difficulty in walking, due to a dragging of the left foot. For a few days there had been constant pain in the back and complete inability to walk. There was marked impairment of sensibility of both legs and on both sides of the abdomen. The knee-jerks were lively and ankle-clonus was present. She was unable to move either leg, but the spastic condition was demonstrated on attempted manipulation. Four days later (December 6) laminectomy was performed, and the cord at a level of the seventh, eighth, and ninth dorsal vertebras exposed. The dura was incised with the escape of considerable cerebrospinal fluid, and at a level of the eighth vertebra a soft, dark-reddish tumor about three-fourths of an inch long and the width of the canal appeared. This mass was removed, and the cord was seen to be much compressed, pushed to the left and flattened.

Dr. W. F. Whitney reported the growth "to consist of a very cellular fibrous tissue with numerous small vessels, and concentric concretions infiltrated with lime salts — a psammoma."

The progress toward recovery in the case has been rapid. At the present time (six months after operation) the patient considers herself practically well. She walks about with an apparently normal gait and without support of any kind, and is able to attend to her household duties. Although the knee-jerks are still increased, ankle-clonus has disappeared and sensibility seems normal over the legs and abdomen. Movements of the legs are unrestricted. A very striking feature of the convalescence has been an entire freedom from pain, so persistent before operation, which formed such a distressing symptom in the first case reported.

Case III. — This case is mentioned to show the beneficent result of laminectomy done as a palliative measure for the relief of agonizing pain in a man known to have an extensive intramedullary growth of the cord.

The patient is now aged forty-nine, and for twenty-five years has shown symptoms of disease of the cord. Sixteen years ago the signs became those of a total transverse lesion, and since then he has been completely paralyzed below the waist, as regards motion, sensation and control of bladder and rectum. Fourteen years ago laminectomy was done by Dr. W. W. Keen, as the patient's general health was rapidly failing, and there existed a possibility of finding a removable tumor. An enlarged bluish cord was seen; the disease was plainly intramedullary. The man's health improved, and for six years there was no marked change in his condition. During all this time he was subject to periodic attacks of pain in the back and shoulders, the attacks being probably associated with the spinal disease.

In January, 1898, pain of great severity became persistent in the neck, shoulders, and arms. Nothing was successful in relieving the pain, which became intolerable. Signs of a progressing paralysis also manifested themselves by numbness in both hands. At a consultation with Dr. Putnam it was decided to perform laminectomy again, in the hope of relieving pressure in the canal. The cord above the old cicatrix was thickened, and had the appearance of soft sarcomatous tissue. No cavities were found on incising the cord, and an examination of fragments removed showed it to be made up of small round cells, probably endotheliomatous in nature. Considerable cerebro-spinal fluid was allowed to escape for two weeks, when the wound closed.

There was rapid improvement in general health, which has been excellent until the present time, now seven and one-half years after. The numbness of the fingers disappeared, and during this time he has had no recurrence of the chills and pain. Within the past two years he has taken up much of his former work as an architect.

The effect of the operation has been most gratifying, for nothing more than a relief of symptoms was expected.

CONTRIBUTION TO THE STUDY OF SPINAL SURGERY. — ONE SUCCESSFUL AND ONE UNSUCCESSFUL OPERATION FOR REMOVAL OF TUMOR.*

G. L. WALTON, M.D., AND W. E. PAUL, M.D., *Boston.*

In case of spinal as well as intracranial neoplasm the hopes raised by the clinical picture are frequently disappointed on the resort to operation. Of this disappointment the writers have had their share. The successful result of operation in one of the cases here reported and the anatomical findings in the second have been welcomed by way of reassurance, both as regards the advisability of operation in progressive and otherwise hopeless cases, provided the symptoms suggest, though they may not absolutely establish, the presence of a new growth. This position has been still further strengthened by a recent brilliantly successful case of Dr. Putnam's, operated on by Dr. Warren, which we had the privilege of seeing in consultation, and which they will doubtless report later.

In the first of the two cases the clinical picture was that of severe pain in the neck and arm, accompanied by local wasting, numbness and loss of power in the arm, and by rigidity of the neck. Operation disclosed a myeloma involving the laminæ and pressing on the dura in the lower cervical region; its removal was followed by relief of pain and rapid improvement of motor and sensory symptoms.

In the second case, pain centering in the right arm, accompanied by a modified Brown-Séquard paralysis of gradual onset and rapid progression, led to the diagnosis of tumor pressing on the cord unilaterally in the lower cervical region. Removal of the vertebral arches failed to disclose the tumor, which on autopsy was found to project posteriorly from the anterior wall of the spinal canal at the level of operation.

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* Reprinted from the Boston Medical and Surgical Journal, cliii, p. 115, July 27, 1905.

Case I. — H. C. Seen at the Massachusetts General Hospital at the request of Dr. Painter, to whom we are indebted for permission to publish the case. The following history was taken by Dr. Painter Oct. 28, 1904:

A man of forty-nine. Pain began about two years ago in arms, legs, and shoulders, not severe enough to keep him from work. In the past two months pain has markedly increased; he has been to several doctors without relief, and is now taking one-half grain morphia a day for pain, and is not entirely relieved. Is losing weight rapidly, has no appetite, bowels move with medicine. The pain is localized about the spine at about the level of the fifth to the seventh cervical vertebræ, extends from this point into the left arm, involving the shoulder, movements of which increase the pain. The patient gets most relief by inclining the head to the left and putting the hand up to the left cheek. Tingling and prickling sensations were the first things noticed in the arm, worse in the little finger, gradually spreading, involving now practically the whole arm, distinctly worse on the ulnar side, corresponding fairly well to the distribution of the ulnar nerve. Has noticed that his arm, especially the hand, was getting weaker than the right, also feels the cold in the left hand very much. Except for the pain in the arm he would feel well.

Examination showed a well-developed, somewhat thin man. The spine showed motions restricted in all directions in the cervical region. The arms showed no marked atrophy. The voluntary movements were all limited, but passive movements showed no involvement of the shoulder, elbow or wrist joints. The left hand was distinctly colder than the right. He felt the point of a pencil distinctly less well on the inner than on the outer side of the arm. The knee-jerks were normal.

He was given general tonic treatment, potassium iodide, ten grams, three times daily and increasing, also codeine, one-half gram three times daily if necessary, three grains at bedtime, and to omit the morphia if possible.

Seen by Dr. G. L. Walton, who advised exploration on the chance of the trouble being a neoplasm.

The following items may be added from the hospital records:

Examination shows movements of the neck restricted in twisting and in lateral bending, especially to the left, marked wasting of the interrossi of the left hand, and very feeble grasp. Patient cannot approximate the thumb and fingers of the left hand. There is loss of the different varieties of sensation on the ulnar side of the left arm and hand. Operation advised.

Operation. — The operation was performed by Dr. J. C. Munro at the Carney Hospital, Nov. 21, 1904. Dr. W. N. Bullard was present.

A median incision was made over the lower cervical and upper dorsal spines. The sixth and seventh (?) laminæ removed. The seventh (first dorsal?) lamina on the left was rough on the outer surface and the upper edge anteriorly was eaten away by a soft gelatinous growth that was pushing out into the muscles and pressing upon the dura. The lamina was removed and the growth was found to extend anteriorly and laterally into a smooth cavity, about one-half inch in diameter, anterior to the level of the articular processes. This growth was curetted out entirely so far as seen and the dura freed from pressure. The dura itself appeared healthy and translucent and was not opened. There was considerable oozing from the cavity, requiring temporary packing of iodoform gauze. The wound was closed in layers allowing for the drains. Patient was in good condition at the close of the operation.

Dec. 5, 1904. The patient went home to-day, general condition much improved, wound firm and healed. No narcotic has been required since operation. The pain in the arm is practically gone, slight pressure below the elbow relieves what slight pain the patient now has. The sensation of hand is much improved, also the grasp. The patient was referred to the out-patient department for electrical treatment, and was given strychnine sulphate, 1-60 gram three times daily for home treatment.

Improvement was continuous and there has been no return to the previous symptoms. We have recently learned, however, from Dr. Painter, that signs have appeared of recurrence of the growth in other localities. This was, unfortunately, to be expected from its nature.

Case II. L. B., fifty-three; married; travelling man; was first seen by Dr. Paul in consultation with Dr. Morris, in September, 1904.

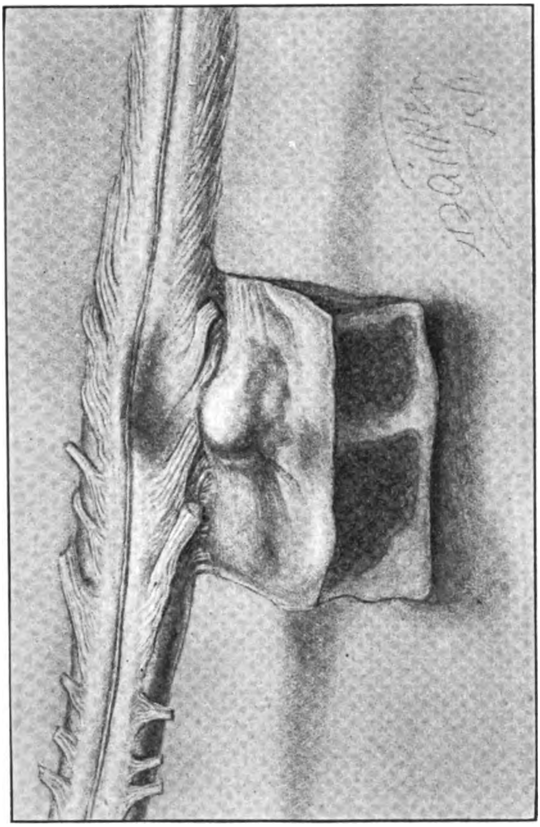
The chief complaint was of pain between the shoulders and down the arms; jumping in character, worse at night and on lying down, at intervals of an hour, lasting about ten minutes, of two months' duration and gradual onset. There was some dull pain also in the legs and thighs with subjective numbness in lower extremities with sensation of pins and needles; and since September 5 there had been a rather abrupt onset of momentary sharp pains in the thighs. The power in the legs had lessened during the preceding month; the patient tired easily and found it hard to walk up or down stairs. There has been loss of flesh (twenty pounds). Sensitiveness to cold has increased; there is burning in the feet at times and coldness of the hands. There has been some loss of sexual power, but no bladder trouble; there has been no girdle feeling, no headache, no disturbance of the mind or special senses.

Physical examination showed a rather stout man with slow and feeble gait, standing well on both feet but unable to stand on either alone. Movements of the hands were normal, but not strong. The movements of the neck were not limited.

Reflexes. — The knee-jerk was lively, especially on the right. Plantar reflex consisted of very slight flexion of the little toe only on the right, on the left there was rather slow flexion of all toes. The cremaster reflex was lively, greater on the left. The pupils were normal. The urine was normal.

The patient was put upon specific treatment, with gradual increase of the iodide to one hundred and twenty grains three times a day, on account of a history of infection in 1899. No amelioration of symptoms followed; the pains increased and became severe enough to wake him in the night.

On October 26 he had begun to drag the right foot, and to find more difficulty in walking. Both hands had now become weak, and numbness was complained of in the abdomen and thighs. Examination at this time showed the right leg cooler than the left, distinct toe drop on the right, loss of pain and temperature sense in the left leg, and impairment of pain and temperature sense on both sides of the trunk, the touch being everywhere felt though not being quite natural. The anesthesia of the trunk reached the height of the third or fourth dorsal vertebra behind and the level of the xiphoid in front. Muscle sense was unimpaired in the feet.



The patient was referred to the Massachusetts General Hospital for observation and possible operation in view of the possibility of intraspinal neoplasm. He entered the service of Dr. Fitz with whom he was seen in consultation by the neurological staff. The distribution of symptoms caused some variation in diagnosis, but in view of the rapidly increasing paralysis there was general consent to exploratory operation. The patient, able to walk upstairs at entrance, became in a short time totally paraplegic and helpless, spasticity with Babinski appearing first in the right and then in the left leg. The blood count showed fourteen thousand eight hundred whites, hemoglobin eighty-five per cent. The day after admission sugar 2.3 per cent appeared in the urine, previously normal, including the examination made at entrance to the hospital.

Operation. — The patient was operated on by Dr. F. B. Harrington. An incision was made from the sixth cervical to the third dorsal vertebra, the muscles drawn aside and the laminæ exposed. The lamina of the second dorsal was cut with a small saw about one-half inch from the spinous process, the interspinous ligament was severed and the process with laminæ removed. The laminæ of the first dorsal and seventh cervical vertebæ were resected and removed with the spinous processes. A considerable layer of fat overlaid the dura. On incision of the dura there was a free escape of cerebrospinal fluid. The cord appeared normal. The muscles were closed with interrupted sutures, a drain having been inserted. The wound was closed about the wick with interrupted silkworm gut.

The patient's condition was poor during the operation and 1-30 grain of strychnia was injected and repeated after his removal to the ward. He was given a shock enema, heaters were applied and the foot of the bed raised. The patient rallied somewhat after a subpectoral salt infusion and the injection of adrenalin and atropin. Oxygen was given five minutes out of every half hour. Dyspnœa suddenly appeared at five the following morning and the patient died suddenly at 9.40 A.M.

Autopsy. — The autopsy was made by Dr. Oscar Richardson, whose description is as follows:

At a point situated just posterior to the intravertebral cartilage between the bodies of the sixth and seventh cervical vertebræ, a small, rounded, firm, slightly elastic mass bulges backward and presses on the cord forming a depression in it about fifteen millimeters in length and twelve millimeters in width and four millimeters in greatest depth. The depression is concave, corresponding with the convex surface of the bulging mass and is situate mainly in the right half of the cord. The bulging mass is also mainly situated to the right of the median line of the bodies of the vertebræ and the dura is closely applied over it.

There is another minute slightly bulging mass similar in character to the one described above and which possibly very slightly depresses the cord. It is situated to the right of the median line and just posterior to the intravertebral cartilage between the fifth and sixth cervical vertebræ.

The cord over the larger bulging mass and opposite the marked depression bulges somewhat posteriorly and appears to be slightly widened. The larger mass, which decidedly depresses the cord, measures about 2 centimeters in length, 1.5 centimeters in width and 6 millimeters in thickness. On section the tissue of the bulging mass is found practically continuous with the tissue at the disc and of about the same color and consistency.

The cord on section shows nothing in addition to the depression mentioned except that a short distance below the level of the seventh cervical vertebra the cord, over a length of about five centimeters, shows here and there along this portion a few small red areas apparently situated in the anterior part of the cord.

Microscopical examination shows the tissue of the intravertebral disc extending into and lost in the tissues of the tumor mass. The tissue of the mass at its base is fibro-cartilaginous in nature and in its upper portions shows connective tissue presenting here and there several spaces which, from the elasticity of the tissues at the time of the autopsy, probably contained some sort of fluid.

This is not the first time that bilateral distribution of anesthesia in the trunk has been observed by the writers in case of otherwise fairly typical Brown-Séquard distribution. This observation would suggest the possibility that the sensory fibers supplying the trunk do not follow their diagrammatic representation. We had some hope that the examination of the cord above and below the tumor would throw light upon the subject through the secondary degeneration of nerve tracts. Dr. Wright examined the cord, however, by his rapid method of freezing and staining, without revealing secondary degeneration in either the sensory or motor tracts.

The fact that no secondary degenerations appeared in the cord furnishes still further encouragement for operation upon spinal tumors extraneous to the cord. So long as the cord receives no irreparable damage, there is, of course, hope of perfect relief after removal of pressure, and it is not impossible even in this case, though the tumor was not removed, that the mere relief of pressure by removal of the laminæ might, perhaps, have been followed by recovery of function and cessation of pain if the patient had survived the operation.

The comparison of the findings and the results of the cases of operation for spinal tumor which have come under the observation of the writers with those of operation for cerebral tumor would indicate a much more favorable outlook for spinal than for cerebral intervention, and yet the occasional successful result recorded even in the field of cerebral surgery would warrant free recourse to the knife in cases of such otherwise unfavorable prognosis.

In deciding upon the general proposition of the attitude one should take, with regard to cases hopeless without operation and offering few and doubtful hopes if exploration is attempted, it seems desirable that one should determine on a general rule in such cases and follow it. For ourselves we believe in giving the benefit of the doubt to operation in all such cases for the following reasons:

First, there is the bald fact that without interference we have to give a hopeless prognosis.

Secondly, in ruling out operation, we deny the patient and the family a legitimate attempt to ameliorate discomforts, if not to effect a cure.

Third, if out of many operations one case only is successful, the result, it seems to us, justifies the endeavor.

Fourth, if selected cases only are operated upon, there is great danger that the present limitation of our diagnostic criteria would cause us to overlook the case in which operation would have been most brilliantly successful.

THE OPERABILITY OF BRAIN TUMORS FROM THE POINT OF VIEW OF AUTOPSIED CASES.*

G. L. WALTON, M.D.

The estimates of the operability of brain tumors based upon autopsied cases, collected by Knapp in 1898, varied from three per cent (Seidel) to seventeen per cent (Dana).

The personal equation, doubtless the main cause of the variations, can be reduced to the minimum by dividing the cases into three classes, namely, operable, inoperable, and doubtful, instead of attempting to draw a sharp line between operable and inoperable.

Into the operable class fall the primary, accessible, well-defined tumors which can be removed without cutting into brain tissue. Such tumors spring in the great majority of cases from the dura; many are designated endotheliomata, a term including spindle-celled sarcomata and certain psammomata, growths in which groups or whorls of cells have undergone hyaline degeneration and calcification (Blackburn). The present tendency is to class these tumors according to their original nature, rather than according to the form of degeneration.

Into the inoperable class fall tumors involving the deeper structures of the brain, as well as most cases of multiple growth and of widespread metastasis.

In the doubtful class may be placed gliomata and non-encapsulated sarcomata in accessible regions, and cysts in which operation can only evacuate the contents. The scepticism prevailing among pathologists regarding the operability of gliomata seems well founded. The attempt to check their growth by operation is merely equivalent to removing a portion of decayed fruit.

With the collaboration of Dr. Paul, I have studied one hundred and seventy-one autopsied cases from the records of the Massachusetts General Hospital, Boston City, New York

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* Boston Medical and Surgical Journal, July 20, 1905.

City, Danvers, Taunton, and Worcester Insane Hospitals, Mt. Sinai Hospital, and Montefiore Home, and the private collections of Drs. Harlow Brooks, J. J. Putnam, and E. W. Taylor, as well as our own. The number was increased to three hundred and seventy-four by a series of published reports.

The results were as follows: operable tumors, 7.5 per cent; inoperable, 79.4 per cent; doubtful, 13.1 per cent.

The combination of operable and doubtful was 20.6 per cent, or approximately the estimate of Dana. Eliminating the cases of other infection, and the cases with no symptoms, the operable cases were reduced on the other hand to four per cent, approximately the estimate of Seidel. This shows the influence of the personal equation.

A number of operable endotheliomata without localizing symptoms were found near the median line and under the frontal lobe, facts which should lead to exploration of the surface, especially in these directions, rather than to puncture of the brain in search of deep-seated removable tumors, which autopsies show to be practically wanting. If both surface exploration and puncture are deemed necessary and safe, the former should precede.

The comparative simplification of classification of tumors is noteworthy. Nearly all are now included under the essential nervous system growths (glioma), the connective tissue growths (fibroma, sarcoma, endothelioma, angioma, angiosarcoma, osteoma), the epithelial (carcinoma, cholesteatoma), the infectious granulomata (tubercle, gumma, and actinomycocis), and the parasitic cysts.

The comparatively rare appearance of gumma is noteworthy, and this clinical diagnosis should not discourage operation.

A fixed plan should be followed in advising operation. In one collection two successive cases were found with identical symptoms; in one operation had been unsuccessfully attempted; in the other no operation was attempted, but autopsy disclosed an easily removable endothelioma in the region indicated by the symptoms.

OBSERVATIONS UPON THE ACTUAL RESULTS OF CEREBRAL SURGERY AT THE MASSACHUSETTS GENERAL HOSPITAL.*

E. A. CODMAN, M.D.

I want to take this opportunity to thank the surgeons of the Massachusetts General Hospital for their kindness in allowing me to report these cases. I think that we all ought to appreciate the good will of the surgeons of the Boston City Hospital and the Massachusetts General Hospital in allowing us during the last two years to make use of their cases for discussion at these meetings. I fully realize, and I know that you, gentlemen of the society, also do, the great obligation we are under for the use of this material *used in the way in which we have used it* at these meetings. We have dragged up and brought to light the results of some very unsatisfactory classes of cases, and it is obvious that the statistics which have been shown at these meetings are somewhat less satisfactory than those which are reported by individual operators in other places.

However, during the last two years we have had ten good meetings on the present policy of presenting actual home-made results and of discussing the directions which improvements may take. Another thing which has developed from this search for results has been the construction of a system of tracing patients after their discharge from the hospital. Each of the younger men who has been kind enough to undertake to trace the results of these cases has contributed a little to the convenience of this system. As perhaps they may be of future service to others, I will mention the points which at present we find useful.

(1.) To write to the friends of the patients at the address given on the entrance books of the hospitals.

(2.) To write to the physician recommending the patients for admission.

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* Reprinted from the Boston Medical and Surgical Journal, Vol. cliii, No. 3, pp. 74–76, July 20, 1905.

(3.) If we suspect that the patients are dead, their names may possibly be found in the State Archives, Room 432, at the State House. The cause of death is frequently given.

(4.) The authorities in Room 36 at the State House have been most kind in giving information about the patients who have later gone to some of the public institutions.

(5.) The town clerk at the place where the patient lived is often able to forward a letter to some relative.

(6.) The police are always obliging in assisting to discover the present residence of the patients.

(7.) Directories of many of the smaller towns and all of the larger cities are kept on file at the Dennison Manufacturing Company, 26 Franklin street, or at the State House.

(8.) People of the same name found in the directory in the town in which the patient resided may be written to to find out whether they have any knowledge of the case.

(9.) In case the patient has moved his lodgings, the people in the neighborhood often know what his new address is, even if it has not been left with the postman.

(10.) Occasionally the house officer who had charge of the case, and whose name is found on the first page of the Record Book, will be able to tell of the result after the patient left the hospital.

These methods have all been used in tracing the present results, and we have been able to find the results in all of the cases operated on for epilepsy and abscesses and all but five of those operated on for brain tumor. The gross facts are down on the table before you. These are not statistics, they are results of our own surgeons' cases, of which we have records.

CLASSIFICATION ACCORDING TO THE INTENTION OF THE SURGEON BEFORE OPERATION.

Operations were Undertaken,	No of Cases.	Deaths within 2 Weeks.	No Improvement.	Improvement.	Not Traced.
1, for the removal of a tumor if possible; if not, to relieve symptoms caused by pressure (notably headache and failure of eyesight)............	28	7	11	7	3
2, purely to relieve pressure symptoms (headache and failure of eyesight).........	8	4	0	2	2
3, for the relief of epilepsy (usually post-traumatic).....	21	0	12	9	0
4, for drainage of a cerebral abscess..................	6	5	0	1	0

From my reading of the records I want to take a few minutes to speak of the points which have seemed to be most instructive.

First, in regard to brain tumors. Obviously there is a large mortality and a very large percentage of "not improved." During the last few years there have been suggested certain factors which may be expected to improve the results in these cases.

(1.) *Diagnosis.* — It is not in my portion of this discussion to speak especially of diagnosis. The only point which I thought might be of interest was the use of iodide of potassium as a diagnostic measure. In this series of cases at least eight of those in which the operation failed were delayed from several weeks to many months by this practice.

(2.) *The permission for autopsy.* — If we are to learn to do brain surgery for the community, the community must consent to the practice of post-mortem examinations. In some of the cases the lack of a post-mortem has been most annoying. I hope some day that no patient will be admitted to a hospital without signing a permission for post-mortem examination in case it is necessary.

(3.) *The prevention of shock and hemorrhage.* — In three of this series death was due to shock and hemorrhage. In many other cases which were not at once fatal mention is made in the records of the difficulty experienced with bleeding and of the extremely poor condition of the patient at the end of the operation. To combat this difficulty Cushing has suggested the use of the pneumatic rubber tourniquet, and Frazier has suggested the use of a dental engine which minimizes the time required to cut out the Wagner flap.

(4.) *Prevention of sepsis.* — Five cases died from sepsis. Of these, three died after a second operation. The custom of doing the operation in two stages is undoubtedly likely to cause sepsis, but its unquestioned value should demand redoubled care in technique. Probably the most common cause of sepsis after these operations is due to the tension caused by protrusion of the brain, which produces a pressure necrosis on the stitches and gaping of the interval between the stitches. For this reason especial care should be taken to approximate the edges of the scalp wound.

(5.) *Prevention of post-operative paralysis and disturbance of speech.* — Of eleven cases in which there was no improvement eight had an increase of paralysis or aphasia develop after the operation. All of these had hernia cerebri. In all the opening was made in the Rolandic area. Cushing has made a most valuable suggestion in relation to the prevention of hernia cerebri. In cases where the operation is purely for the relief of pressure he proposes trephining over a "silent" area of the cortex so as to avoid the strangulation of the important motor area by the constriction of the hernia cerebri in the bony gap. On the analogy of the intermuscular operation for appendicitis he recommends an intermuscular incision through the temporal muscle and the removal of the squamous portion of the temporal bone on each side.

This brings me to the most important observation to be made from the analysis of these cases. Should we not, instead of aiming to do a radical operation in cases of tumor of the brain, be satisfied with a purely palliative operation?

In the first place, observations at autopsy, as I think Dr. Walton will be able to show, reveal the fact that of all brain tumors a very small percentage are really removable, and that of those that are really removable the greater number arise from the dura.

Second, the cases at the Massachusetts General Hospital show that even those that are really removable, as shown by autopsy, are most difficult cases to handle, and that in the hands of these surgeons not one of the twenty-eight cases has been successful as a radical operation.

Third, that of all those cases which have lived through the ordeal of the operation a considerable percentage was improved only by the relief of pressure, and that in those cases which were not improved the failure was probably largely due to the strangulation of the motor cortex through the trephine hole, or to damage done to the brain tissue.

In twenty-eight of the thirty-six operations the attempt at a radical removal of the tumor was made, and in only the eight worst cases was it decided to do only a palliative operation. I think that we may almost say that it is certain that if in no case the attempt at radical removal had been made and, instead, a simple operation for the relief of pressure had been done through an intermuscular incision over a "silent" portion of the cortex, that the mortality would have been greatly diminished and the percentage of improvement been made much greater. I do not mean to say by this that radical operations in the hands of a surgeon who has made a specialty of brain work is not justifiable, but that in the hands of most of us a simple palliative operation will be far better in the long run.

Lumbar puncture has not proved a satisfactory method of relieving intracranial tension, for of the four cases in which this operation has been done at the Massachusetts Hospital two stopped breathing on the table and, although the pulse could be kept up by artificial respiration for several hours later, the respiratory center remained paralyzed. In one other case the same failure of respiration occurred from a simple attempt to etherize without operation. In none of these three cases was the attempt made to trephine the skull under artificial respiration, although it seems possible that relieving the intracranial tension in this manner might have enabled the respiratory center to resume its function.

Another point, which is to be learned from the records of these cases, is that in no case was any good accomplished by exploration in the brain tissue itself, by means of incision or explorations with probes or aspirating needles, unless on the surface of the brain itself there was some indication of the existence of a cyst or tumor. The indication was in some cases adhesion of the dura or pia, in others a discoloration of the brain surface, and in others a sense of resistance to the touch. In but three cases was a radical removal of a tumor actually done. Two of these died almost at once and the third recurred later.

I may sum up the observations on brain tumor by saying that the reading of these records has made me personally feel that the chance of any success by radical operation was so small that in any given case diagnosed as brain tumor, even if the symptoms gave evidence of a more or less exact localization, it would be wiser to do an operation simply for the relief of intracranial pressure, rather than to explore with the idea of removing the tumor. That surgical endeavor in brain cases should, for the present, aim rather at devising an operation which might give relief to intracranial tension without exposing the important motor area to trauma and strangulation through the opening in the skull. It would be particularly satisfactory if an exploratory operation could be devised which might serve at the same time to expose a large area for the inspection of the surface of the brain and when the flap was resutured could be so arranged as to prevent bulging of the motor area. Possibly this could be done by removing all of the bone in a large osteo-plastic flap, except the portion covering the motor area, and wiring this portion *in situ.*

REPORT ON RESULTS OF BRAIN AND CORD SURGERY AT THE MASSACHUSETTS GENERAL HOSPITAL.*

JAMES J. PUTNAM, M.D.

It has not been the good fortune of the Massachusetts General Hospital, as Dr. Codman has pointed out, to relieve entirely any one of the thirty-six patients who have been treated for *brain tumor* by operation. In no case has there been complete removal of the growth with recovery of the patient and, judging by the post-mortem evidence, the showing in this respect is likely to be slightly, but not radically, better in the future. On the other hand, a considerable degree of palliation has been secured in nine cases, and a scrutiny of the details leads to the conclusions, first, that palliation is a result worth striving for, and next, that if held systematically in view it can be gained oftener and in greater perfection than it has been heretofore.†

The best results have been the following:

Case I. — The first case is one already reported by Dr. M. H. Richardson and myself, where a great mass of sarcoma, weighing about a pound, was removed from the left hemisphere at the second of two operations, with complete relief from intense headache and approaching blindness. The patient had become partially crippled and aphasic, but positively enjoyed life for a year and died without a renewal of acute suffering. His wife felt that a great deal had been gained. At the autopsy the greater part of the left hemisphere was found to have been invaded by the growth.

Case II. is that of a patient who has recently died and has been shown to have had a glioma of the lateral lobe of the cerebellum, impinging on the pons Varolli. Although the tumor was thus below the tentorium cerebelli, a marked relief from terrible headaches and optic neuritis followed the making of a large trephine opening in the parietal region, and this, too, although the bone was replaced. This improvement was attributed to the escape of cerebro-spinal fluid, which gushed in large quantities from the wound in the parietal dura, and presumably relieved for a time the distended ventricles. Some months later, the headaches returning, large openings were made also in the occipital region, but the patient continued gradually to fail.

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*Boston Medical and Surgical Journal, July 20, 1905.

†Since this report was made the technique of palliation has been more carefully and effectively studied.

Case III. — A third patient, a young married woman, suffering likewise from headache and impaired eyesight, and also from epileptiform seizures and from motor aphasia, due to a sarcoma of the frontal lobe, received a measure of relief which her husband reckoned as considerable. In this case a large tumor mass (part of which was removed) protruded through the trephine opening, pushing the skin before it. Its presence caused no serious inconvenience, and it was felt that to tamper with it further would give rise to permanent aphasia.

Case IV. — Again, in a fourth case, with severe general symptoms of the sort already noted, and, in addition, considerable mental failure, the improvement was such as almost to justify a return to work, although an incomplete paralysis of the left hand — less to be sure, after the operation than before it — would have made work difficult. But after some months of this improvement this patient also failed again and died.

Case V. — A fifth case was one of special interest because of great improvement in respect to epileptic seizures, an improvement which still maintains itself at the close of two years, in spite of the fact that a glioma of undefinable margins was discovered at the operation. The patient has worked ever since the operation was performed and is still working.

In the other cases of this class the improvement consisted only in the fact that the patients became less acute sufferers, on the whole, and more easily taken care of by their friends. This care, although often difficult enough, was usually softened by a postponement of the fatal issue, permitting a gradual habituation to the idea of incurability, and a relief of the desperate feeling which almost demands that the prognosis of " hopeless " shall not be accepted without one struggle for a better outcome.

With regard to the question whether there is an outlook for a more favorable record in the future, either as regards the removal of tumors or palliative operations, I think the conservative physician and surgeon can speak with reasonable hopefulness. There are two relatively new directions in particular in which there is a fair prospect of gain through radical operations. One is in the removal of syphilitic gummas, the other in the removal of tumors of the cerebellum, even those which lie in the so-called cerebellar-pontine angle. No syphilitic cases are included in our list, but a number of successful results have been reported elsewhere, and it has always seemed to me probable that the improvement in circulation consequent upon the removal of pressure would prepare the way for a more effective use of iodine and mercury.

The outlook for the removal of cerebellar growths is better for the fact that it has been found possible to mutilate the cerebellum to a considerable extent without causing serious or uncompensated derangements of brain function, and also because of the freedom with which large pieces of the cranial bones are now taken from the occipital portion of the skull, the presence of the dural sinuses offering no serious check to such an operation.

Dr. S. J. Mixter has recently operated upon two private patients of my own with marked success, obtained largely through recognition of these principles. In one case an endothelial sarcoma was wholly removed from the posterior border of the cerebellum; in the other case, although the tumor was not found, the operation was followed by an extraordinary and thus far a persisting improvement in the condition of the patient.

It is also reasonable to believe that tumors (neuro-fibromata) growing from the cranial nerve-roots of the pons, or from adjacent structures, and occupying the angle between the pons and cerebellum, will occasionally be successfully removed, though the attempt may entail the cutting away of a large piece of one cerebellar lobe.

The whole subject of the diagnosis, pathology, and treatment of cerebellar tumors has recently been carefully reviewed in an able series of papers by Drs. Mills, Frazier, Weisenburg, and De Schweinitz of Philadelphia, and Drs. Joseph Fraenkel and Dana of New York, published in the New York Medical Journal and Philadelphia Journal for February, 1905; and in a very valuable article based on the analysis of forty cases, by T. Grainger Stewart and Gordon Holmes, published in Brain, Winter number, 1904.

The statements there made are full of interest and encouragement, although I cannot agree that either clinical or post-mortem evidence bears out Dr. Mills' opinion that from twenty-five per cent to fifty per cent of cerebral tumors are likely, eventually, to be treated through surgical operation with marked benefit to the patient. The estimation of benefit in these brain cases is, however, not easily expressible in statistical form. A single successful result, when attained, is often such a cause for gratitude as to justify many disappointing efforts.

As regards palliation I agree with Dr. Codman that, as a rule, palliation means relief of pressure, and that this will be better secured, and more safely, if the operation is addressed distinctly to that end. But sometimes palliation means also partial removal of tumors, and this should be done on the basis of the most thorough neurological localizing diagnosis. Fortunately, the data for such diagnosis are continually accumulating, and often permit a considerable degree of accuracy, even where the Rolandic area is not in question.

The experience of the hospital in the *surgical treatment of epilepsy* is primarily expressed in the statement that, out of twenty-one cases treated, nine received benefit, while twelve received no benefit.

This is really a large proportion of good results, and I ask your attention to a brief analysis of a few of them.

Case I. is that of a young man of twenty, suffering from attacks of Jacksonian epilepsy involving the right hand and occasionally leading to loss of consciousness, induced by a cortex-lesion set up by a meningeal hemorrhage which had come on during a typhoid fever, fourteen years previously. Trephining over the Rolandic area revealed a localized meningitis, and a small excision there caused a paralysis of the hand which quickly passed away. As time went by the patient grew better and better and for some years past he has been substantially or wholly well.

Case II. — Another case should be mentioned in conjunction with this one, in which the symptoms were essentially the same as those just now recorded. Here several slight, cord-like, meningeal adhesions were found at the operation, probably due to a severe blow upon the head in childhood. No considerable improvement followed the opening of the skull or the removal of the adhesions.

The surgeon would have been justified in removing large pieces of the cortex in both these cases, with the hope of extirpating an epileptogenic center, but the physiological basis for this operation is not quite sound, and the question of its clinical value is still in the balance.

In the case first reported, the favorable issue did not show itself in full force until some years after the operation, and, of course, the causal connection is uncertain. The same doubt obtains as regards the next case, and yet both belong in a category where spontaneous improvement is a rarity.

Case III. — This case was one of epileptic attacks due to fracture in the temporal region in boyhood, leading to a thickening and adherence of membranes at the seat of injury. Better surgical conditions for repair were secured by operation, but for a year no improvement followed, and it became necessary to send the patient to a hospital for the insane, where he remained two years. At the end of the first year, however, improvement began, and for twelve years he has been substantially or wholly free from attacks, and supporting himself by work.

Case IV. — In a fourth case, already studied and reported on by Dr. A. T. Cabot, a brilliant result followed thorough draining of a subcortical cyst which had caused a typical epilepsy of the Jacksonian type. The patient was enabled to return to work, freed from his attacks, to marry, and to carry on, for several years, an extensive business, although he was finally overtaken by his enemy and died.

Case V. — Dr. Beach has likewise reported the case of a young girl, relieved for several years of epileptic attacks due to head injury from a kick of a horse in childhood. The operation consisted in the surgical cleaning up of a condition due to badly healed fracture. After a time, the attacks returned and persisted, in spite of a second operation.

Case VI. — In this case a marked and very satisfactory improvement followed extensive removal of carious bone and thickened membrane from the skull of a syphilitic adult man, although eventually the symptoms returned and the patient died.

The history of these cases, taken in connection with the experience of others, leaves no room for doubt that the cleaning up of the results of old injuries to the cerebral membranes and skull results favorably in a fair number of cases. The favorable outcome seems to be due in part to the removal of reflex irritations and to the securing of better conditions of local nutrition of the cortex. The results are, however, strangely variable, and there is a mystery hanging over the matter which only a far better knowledge than we now possess of the physiology of the brain and the pathogenesis of epilepsy can dispel. The most important point as regards the treatment of epilepsy by operation is as to the value of excision of motor areas of the cortex in cases with localized aura. This is still in doubt. There is much to say of a practical character in its favor, but our knowledge of the physiology of the brain and the genesis and nature of the epileptic seizure is still too immature to be utilized satisfactorily as the basis of so radical a procedure.

It would be idle to claim that this report represents the best that neurology and surgery can accomplish in the operative therapeutics of these important diseases. It is a bare record of interesting hospital experiences, acquired through a conscientious following of established methods. The next report, rendered perhaps at the termination of another decade, will doubtless tell of more instances of success. But when the time comes that in each one of our great hospitals one surgeon is given the opportunity of cultivating this branch of neurological surgery as a specialty, then first we shall be able to do our best work. Surgeons with neurological training are positively needed. The difficulties in the way of deciding whether to operate, where to operate, and how to operate are so great that the man who is to succeed must have long bathed to the neck in physiological, pathological, and neurological research, and must have made "his hands the ready servants of his will," in that particular line. The most useful hospitals of the future, from the standpoint of the community, are likely to be strongly characterized for their encouragement of specialism and "team-work."

It might be urged that brain surgery, at the best, presents but little of attraction for the specialist. But this is not true if brain surgery is considered in its proper place as one branch of the large field of neural surgery. I recognize the difficulties in the way of promoting specialism of such sorts and do not pretend to offer a solution. Yet while they remain unsolved we must be content, as a rule, to follow where others lead, though the work will always be guided by conscientiousness and intelligence.

The work of the hospital on spinal-cord surgery has been interesting and encouraging, especially as regards the operation for tumors. Most of these cases have been reported elsewhere and I have omitted all reference to this branch of our work from this communication.

ANGIO-NEUROTIC EDEMA: REPORT OF A CASE OPERATED UPON DURING AN ABDOMINAL CRISIS.*

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Definition. — Angio-neurotic edema is a disease which is characterized by local edematous swellings, more or less limited in extent, and of transient duration. These swellings appear upon various parts of the body, such as face, hands, arms, legs, genitals, buttocks, and throat. In several instances patients have died of edema of the glottis.

Associated with the superficial edema are nearly always seen gastric disturbances, — colic, nausea, vomiting, and sometimes diarrhea.

There is a strongly marked hereditary tendency. Several instances of this have been reported, the most remarkable of which is that of Osler, who traced the disease to five successive generations of the same family. The disease begins in early childhood and recurs only at rare intervals during the first few years. As the patient grows older the recurrences grow more frequent, until attacks are suffered nearly every week. In brief, the above is a rough picture of the disease as described by Osler and other writers.

Etiology. — It is closely allied with several other neurotic disturbances, such as urticaria, purpura, erythema, etc. In fact, in certain patients, the neurosis seems to show itself under various manifestations which are classed as separate diseases, as they appear, according to the symptoms, complex.[1]

Angio-neurotic edema is the term which applies in those cases where edema is present. This edema is of sudden onset and usually shows a constant tendency to attack special parts of the body. In some individuals it is characteristic of the disease to start in the fingers, and in others in an eyelid, etc.

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*Reported at the Clinical Meeting, Massachusetts General Hospital, Dec. 2, 1904. Reprinted from the Boston Medical and Surgical Journal, Vol. clii, No. 13, pp. 362, 363, March 30, 1905.

[1] Osler, Am. Jour. Med. Sciences, 1904, Vol. 127, p. 1.

The precipitating causes of an attack may include any temporary disturbance of the organism, as indiscretions in diet, exposure to cold, or exertion. It has been shown, however, that the disease has a proclivity to return at definite intervals of less and less duration, whether or not excited by outside influences. Matas has reported a well-known case in which this periodic occurrence was of such regularity that it simulated malaria.

Pathology. — The pathology of the disease is apparently simple. There is supposed to be a sudden great increase in the permeability of the vessels allowing serum to exude into the tissues. There has been but one thorough study of the visceral lesions, which was made by R. S. Morris.[1] In one of his cases the stomach tube, which was used to relieve intractable vomiting, brought up a good-sized piece of the stomach mucosa. Microscopical section of this tissue showed a marked infiltration of all parts of the mucous membrane with edema. There are three previous cases with severe abdominal disturbance in which laparotomies have been performed in angio-neurotic edema, — by Sutherland, Burrows, and MacRae, respectively. In the first two, limited areas were discovered in the small intestine which were the seat of moderate-sized extravasations of blood and edema.

Symptoms. — The symptoms may be divided into two general types: the superficial skin manifestations and the various visceral disturbances. The earliest attacks are mild and are limited to swelling of the skin in various regions. A typical attack may begin with itching and redness at the point where the swelling is about to appear. A finger will then suddenly begin to swell until it is so surrounded by splint-like support of edema that it is impossible to flex the joints. The edema may last for a few hours and then subside, or it may extend to the forearm and reach even to the elbow. At its height the swelling is firm and elastic to the touch, and only when it begins to subside can pitting be obtained upon pressure.

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[1] Am. Jour. of Med. Sciences, November, 1904.

For the first few years the manifestations are limited to the skin, when gradually abdominal symptoms become prominent. The abdominal symptoms may be due either to gastric or to intestinal lesions, or to both. Colic, vomiting, diarrhea and occasional passage of blood are the usual symptoms. The pain ordinarily begins in the epigastrium and spreads over the abdomen. It is a generalized pain and does not radiate to the shoulder blade or other diagnostic localities. At first the painful attacks may show themselves once a month and disappear after a few hours and without further disturbances, but later in the disease nausea and vomiting supervene in each attack. The pain is probably due to interference with the functions of the stomach and intestines by the edematous deposit.

Beside the two broad classes of symptoms just mentioned, there are various deviations from the common type, when more vital organs become affected by the edema. The brain, kidneys, heart may each undergo such an exudation with the serious resulting symptoms which accompany the derangement of vital organs.

The idea of this report, however, is not a comprehensive study of angio-neurotic edema, but to describe a case which was operated upon during an abdominal crisis.

REPORT OF CASE.

M. O., age twenty-six; single; factory girl. She had been in the Massachusetts General Hospital four times, twice in the surgical and twice in the medical services.

The first symptoms which brought her in were strongly suggestive of gallstones, but her subsequent story shows that undoubtedly the condition was an abdominal crisis in angio-neurotic edema.

The family history is defective as yet, but no other case of edema can be discovered among her relatives.

Previous history. — The first attack came on fifteen years ago. The swelling came in the hands and the feet, where it was closely confined. As usual no pain accompanied the skin lesions. She has been having these attacks ever since at decreasing intervals, the longest periods of freedom being three months. During the last few years, however, she has never passed more than two weeks without undergoing an attack. At present the swellings are no longer confined to the hands, but extend up to the elbows, though in the feet the edema never reaches above the ankle. Her face is less frequently affected, but now and then is deeply edematous from the eyes downward, even to the clavicle. The face looks round at such times, the lips are large, and eating is attended with great difficulty, while swallowing liquids causes nausea. She has never yet been dyspnœic. The head swelling reaches its height in about one day, the lips puff up quickly and remain so for four or five days. In this disease the edema acts exactly as it does under other circumstances, *i.e.*, the exudation comes rapidly in tissues which are loosely constructed, as the lips, while in denser tissues, like the fingers and the toes, the swelling has a comparatively gradual onset and a more rapid subsidence.

Besides the regions mentioned above the patient has noted swelling over the scapulæ, buttocks, and in the breasts. The abdominal pain is not well defined, but extends across the lower half of the abdomen without radiating into the back or the shoulder. Such attacks usually persist for twenty-four hours and are also marked by nausea, vomiting, and headaches. The vomit is liquid and green, never bloody, and one to two quarts at a time. She has never been jaundiced, but is constantly troubled with gas and distress after meals. Her bowels are regular, never bloody.

The urine during an abdominal attack shows the following:

Color, normal; reaction; acid; sp. gr., 1,022; alb., slight trace; sediment, rare hyaline cast.

The stomach contents after test meal:

Free hydrochloric acid, .01 per cent; total acidity, .018 per cent; no lactic acid, few Boas bacilli and yeast spores; stomach capacity, forty-four ounces.

After consultation with Dr. H. F. Vickery, who had made a diagnosis of angio-neurotic edema, it was decided that exploratory operation was justifiable because of the duration and the severity of the abdominal symptoms. The patient was informed that no definite lesion might be found as no definite diagnosis of the abdominal symptoms had been made. She gladly accepted the suggestion of abdominal exploration.

On Oct. 28, 1904, the patient was operated upon by me during an attack of abdominal colic. The stomach walls and each abdominal organ were carefully examined, but nothing explanatory could be discovered, except the intestinal condition. There was a good amount of clear free fluid among the intestines and filling the pelvis. The intestines themselves were engorged with blood, and so red that a mild peritonitis was at first suspected. There were no hemorrhagic areas in the intestinal walls but, at a point within a short distance of the ileo-cecal valve, a cylindrical enlargement of the ileum two and one-half inches long was brought to light which entirely surrounded the gut, increasing the bowel circumference to twice its ordinary size. The swelling was evidently in the bowel wall, elastic to touch and did not pit upon pressure. It can be easily understood how such an infiltration could derange peristaltic action of the intestine. The lower border of the stomach was about half an inch below the umbilicus, and the pylorus admitted the tip of the index finger. The appendix seemed somewhat thickened and was removed, but at examination it was found to be normal. The engorgement of the intestines and the free fluid were explained by the violent peristalsis brought on in the effort to force down the lesion which was actually in the intestinal wall. There was no distention above the lesion since the finger could be easily passed into the swelling at either end.

She had a comfortable convalescence, though some colic attended the first movement of the bowels after operation. An attack of skin swelling came on before her discharge, but otherwise she has not suffered any unpleasant sequelæ.

Osler has written most instructively on this subject. In the American Journal of the Medical Sciences, May, 1904, "On the Surgical Importance of the Visceral Crises in the Erythema Group of the Skin Diseases," he says: "The possibility of mistaking these visceral crises for appendicitis or intussusception or obstruction of the bowel, and handing the patient over to the surgeon for operation, is by no means remote." He relates three cases which were operated upon, and says: "The practical lessons to be drawn from these three cases in which laparotomy was performed are first, that with children with colic the greatest care should be taken to get a full history, which may bring out the fact of previous attacks, either of the skin lesions, of arthritis, or of intestinal crises; and secondly, to make the most careful inspection of the skin for angio-neurotic edema, purpura, or erythema."

THE RESULTS OF OPERATIVE TREATMENT OF GENERAL PERITONITIS FOLLOWING APPENDICITIS, AT THE MASSACHUSETTS GENERAL HOSPITAL, DURING THE PAST FIVE YEARS.*

WILLIAM C. QUINBY, M.D., *Boston*.

To draw statistical deductions from the records of such a class of cases as that of general peritonitis following appendicitis must involve a certain amount of error. The conceptions and definitions of what constitutes a general peritonitis are so infinitely varied that at first sight it might seem that any such numerical expression of results would be absolutely invalidated. While from the point of view of absolute accuracy this is true, nevertheless general conclusions approximating the truth can doubtless be drawn. It is, therefore, with the hope of general rather than specific accuracy that the following results are offered.

In the records are found classed as general peritonitis all grades of cases, from those of appendix abscess with a certain amount of clear fluid free about it, to those cases where the appendix, sloughing and gangrenous, has not become walled off, and pus is found literally in every region of the abdominal cavity. It immediately becomes evident that some definition of general peritonitis must be devised according to which the cases may be classified.

Since the formation of pus is the latest stage of such inflammatory conditions as this of which we treat, and since there is in every case the greatest probability of its containing infectious organisms, it has been thought best to consider a case one of undoubted general peritonitis where at operation it was demonstrated that pus was situated throughout the cavity, and to consider as doubtful those cases where it was localized in the flank or pelvis, and so on.

This classification is necessarily arbitrary, and at the most can only succeed in separating the cases into two groups, the first of which includes those cases in which the process is spreading, while the second concerns only those cases in which it has been shown to be already general, as judged by the diffuse localization of pus.

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* Reprinted from the Boston Medical and Surgical Journal of March 25, 1905.

As types of these two groups the following brief cases may serve to make the distinction somewhat clearer:

GROUP 1. SPREADING PERITONITIS.

Man, thirty years. Sick two days. Marked spasm and tenderness of the right side of the abdomen; none on the left. No shifting dulness. Temperature 102°, pulse 108, respiration 30, whites 17,000. Operation showed pus in the pelvis and cecal region, with a slight amount of turbid fluid in the right flank. Appendix gangrenous. The culture showed colon bacilli.

GROUP 2. GENERAL PERITONITIS.

Man, twenty-three years. Sick two days. Pale, peritoneal facies. Abdomen slightly distended and especially tender in the right lower quadrant. Dull in both flanks, and above the pubes, the dulness shifting with change of position. Temperature 100.4°, pulse 100, respiration 34, whites 16,000, iodine reaction positive

Operation showed a large amount of cloudy fluid on entering the cavity. Thick pus was found about the appendix and in the pelvis, while the epigastrium, hypogastrium, left flank, and splenic regions contained a turbid sero-purulent fluid. Appendix perforated and gangrenous. Culture from hypogastrium showed streptococci.

In collecting the following figures, only the operated cases have been considered.

Taking the cases as found, the following can be deduced:

Whole number of cases, 161.	Lived	55	34%
	Died	106	66%

Average age 23 years; Males, 72%, Females, 28%

By year.	Number of cases.			
1899	25	Lived	7	28%
		Died	18	72%
1900	35	Lived	8	23%
		Died	27	77%
1901	43	Lived	15	35%
		Died	28	65%
1902	25	Lived	9	36%
		Died	16	64%
1903	33	Lived	16	48%
		Died	17	52%

Excluding all cases except those which fall within the requirements of our second group we find the following:

Number of cases of undoubted general peritonitis, 81,	Lived	24	30%
	Died	57	70%

Of the above fifty-seven fatal cases the various times of death after operation may be summed up thus:

Within the first 24 hours after operation	17 or 30%	died.
On the 2d day after operation	7 or 12%	died.
On the 3d day after operation	8 or 14%	died.
On the 4th day after operation	3 or 5%	died.
On the 5th day after operation	4 or 7%	died.
On the 6th day after operation	3 or 5%	died.
On the 7th day after operation	3 or 5%	died.
During the second week after operation	7 or 12%	died.
Over two weeks after operation	5 or 9%	died.

Of these fatal cases those which were ill the shortest time before operation seem in general to be those which survived it the longest, though the data are too inconclusive to express this point numerically.

As to the results following different methods of operation, such as washing *versus* wiping, it has been impossible to draw conclusions, since in practically all cases the abdomen was more or less thoroughly washed with salt solution at some period of the operation.

So, too, the reports of cultures as they stand in the records do not suffice to deduce anything as regards the relative toxicity of the various bacteria found.

A secondary operation for the condition of peritonitis, following the primary one, seems from our cases to be almost invariably fatal, only one case having survived.

THE DIAGNOSIS AND TREATMENT OF FRACTURE OF THE CARPAL SCAPHOID AND DISLOCATION OF THE SEMILUNAR BONE. WITH A REPORT OF THIRTY CASES.*

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It has been the intention of the authors in this paper to draw the attention of surgeons to more systematic observation, and to more exact methods of diagnosis and treatment of carpal injuries than is shown to exist by the present literature of the subject. We realize that in individual instances many of the authors whose opinions or whose cases we have quoted have been able to interpret and successfully treat similar cases to those which we publish, but from our own observations and experience we know that many other such cases are not understood, and hence are not successfully treated. Undoubtedly such cases here and there have been recognized and properly handled, especially since the X-ray has been in general use; but we believe that the profession at large does not realize that many obstinate sprained wrists are instances of fracture or dislocation of the carpal bones, and that the treatment of such injuries should be known as definitely as those of fracture or dislocation of any other joint. The conclusions which we have come to in our study of this subject have been founded on our own observations on the cases we have seen and treated, and though in reviewing the literature we have found attention called to many of the points which we have noted ourselves, we have nowhere found the whole field covered.

We feel that the results obtained in our operated Cases 8, 9, 10, 11, 16, 17 justify our recommending a somewhat radical treatment, because the cases which have been treated conservatively have neither recovered so quickly nor so completely as those on which we have operated. Nevertheless, we realize that it is a delicate question to decide whether the risk of sepsis would overbalance the prospect of gain in functional usefulness.

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* Abstract of paper published in the Annals of Surgery, March and June, 1905.

We desire to summarize the important points in our paper as follows:

1. "Sprains" of the wrist which do not promptly recover are in many cases fractures or dislocations of the carpal bones.

2. The large majority of such carpal injuries are either simple fractures of the scaphoid or anterior dislocations of the semilunar bone.

3. These two injuries are frequently combined, and in such cases the proximal fragment of the scaphoid is usually dislocated forward with the semilunar.

4. Simple fracture of the scaphoid gives a definite clinical picture, and may be recognized even without the X-ray by the association of the following symptoms, viz.: (*a*) The history of a fall on the extended hand; (*b*) localized swelling in the radial half of the wrist-joint; (*c*) acute tenderness in the anatomical snuff-box when the hand is adducted; (*d*) limitation of extension by muscular spasm, the overcoming of which by force causes unbearable pain.

5. A broken scaphoid has little power of repair and appears capable of but slight callous formation.

6. Fractures of the scaphoid which remain untreated or are treated by massage and active and passive motion generally, if not always, remain ununited, and the original symptoms often persist for years with only slightly abated intensity

7. Cases of fracture of the scaphoid may unite if motion of the wrist is prevented during the first four weeks after the injury, but if by this time no union has occurred, future union is unlikely.

8. Excision of the proximal half of a fractured scaphoid gives a somewhat better result than conservative treatment.

9. A posterior incision to the outer side of the tendons of the extensor communis digitorum gives an easy and safe access to the proximal half of the scaphoid.

10. Passive motion of the wrist-joint and active motion of the fingers should be begun within a week after this operation.

11. The possibility of the existence of a bipartite scaphoid should be considered in interpreting X-rays of simple fracture of the scaphoid, but its occurrence must be very rare in comparison with fracture.

12. Anterior dislocation of the semilunar bone should be recognized clinically, even without the X-ray, by the association of the following symptoms, viz.: (*a*) The history of an injury of considerable violence to the extended or twisted wrist; (*b*) a silver-fork deformity, the posterior prominence of which corresponds with the head of the os magnum, and between which and the lower end of the radius is found a groove representing the position formerly occupied by the now anteriorly dislocated semilunar; (*c*) a tumor under the flexor tendons of the wrist just anterior to the lower end of the radius; (*d*) a shortened appearance of the palm as compared to the other hand; (*e*) stiffness of the partially flexed fingers, motion of which, either active or passive, is painful; (*f*) the persistence of the normal relation of the styloid processes of the ulna and radius and the existence of shortening of the distance from the radial styloid to the base of the first metacarpal.

13. Recent dislocations of the semilunar may be reduced with good result even after the fifth week by hyperextension followed by hyperflexion over the thumbs of an assistant held firmly in the flexure of the wrist on the semilunar.

14. Irreducible dislocations demand excision of the semilunar and the whole or a portion of the scaphoid if there is a coincident fracture of the latter.

THE STOMACH: DILATATION TREATED WITHOUT OPERATION.*

JAMES G. MUMFORD, M.D.
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In this paper I propose to tell of sixty cases of gastrectasis treated in the Medical Wards of the Massachusetts General Hospital in the years 1888–1903, and of the end results which it has been possible to ascertain. In the list those cases are not included in which definite diagnoses of organic disease were made.

The cases described here were chronic dyspeptics who had suffered anywhere from a year to a life-time and were admitted to the hospital wards for treatment. They are listed in the hospital catalogue under "Dilatation of the Stomach" because no more accurate diagnosis was made. Why in the light of subsequent investigations some of these cases were not more carefully analyzed it is hard to see.

There are recognized by clinicians a male and a female type of dilatation; the male type is more likely to be a great lateral dilatation, discovered by tympany above the umbilicus, extending beneath the ribs upon the left and pushing up the diaphragm. This type is frequently seen among alcoholics in dispensary practice, and is usually successfully treated in out-patient departments. It is not to this alcoholic type that we refer — indeed, of the forty-one male cases to be described, six only could in any sense be called alcoholics.

The female type of dilatation is the long stomach distended towards the pubes, usually associated with gastroptosis, though a prolapsed stomach is not necessarily always dilated. We used to regard many of these cases as atonic and doubtless many of them are so; but, in the experience of the Massachusetts General Hospital, the majority of atonic cases, if curable or susceptible of relief, find their benefit in the Out-Patient Department and are not met with in the hospital wards.

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* Reprinted from "Surgical Aspects of Digestive Disorders," The Macmillan Co., 1905.

There were listed in the index catalogue of the hospital, in the fifteen years, one hundred and seventeen cases of "Dilatation of the Stomach." We have traced sixty of those cases — a little more than fifty per cent; of the fifty-seven untraced cases it is probable that many are dead. Certainly dead men are less easily discovered than the living.

A passing word about those fifty-seven lost cases. We have a record of their condition when they left the hospital: one was "well;" sixteen were "much improved;" twenty-seven were "improved;" eight were "slightly improved;" five were "not improved."

Of the fifty-seven cases, forty-two were males and fifteen were females. The average age of the males was 46.5 years; the average age of the women 42.6 years; — not that there is any special interest or significance in these figures, except that they will be found to correspond later with those of the patients who have been traced. The records show that when those traced cases left the hospital there were two well; two unimproved, and forty-seven improved; nine patients died in the hospital. At the time of our investigation the report is as follows:

In sixty cases traced: well seven; unimproved nineteen; improved five; dead twenty-nine.

This is not an encouraging showing; let us consider, however, some of the facts and figures in detail and learn what we may of this interesting but unclassified group.

In the first place it is striking that, of sixty cases, forty-one were *male* and nineteen were *female;* while at the same time the hospital records show that during that period of fifteen years the total female entries of all classes of cases somewhat exceeded the male entries. The explanation for the reversal of figures in the cases under consideration probably lies in the fact that the majority of women with stomach disease who entered the hospital were found to have clear histories of gastric ulcer and were listed under that heading.

The *Ages* of the men varied greatly; the youngest was twenty-seven, the eldest was sixty-four, and the average age was forty-seven years. The youngest woman who entered was twenty-two years, the eldest was sixty-nine, an average being 40.3. These figures correspond closely with those usually given, and when we come to study diagnosis it will appear that cancer, when the patients were admitted, was less commonly seen among the women than among the men.

The *Duration of symptoms* in both sexes varied all the way from twelve months to forty years.

As one would expect, the *Loss of weight* varied greatly, though the records do not always state the exact figures. The variation, however, runs from zero up to a loss of one hundred pounds, and seems to be of no special value in throwing light on a more refined diagnosis.

Pain was an almost constant symptom in these sixty cases; five only of the patients were without it. It is variously described as coming on immediately after eating, several hours after eating, relieved by eating to return later, and many times as being constantly present. As one would expect, when there was pyloric obstruction, *late* pain was much the most common. It is described as a burning, gnawing, throbbing, dull and boring pain; and many persons are found in the class who complain of constant pain. In all the cases it appears that the pain was relieved by vomiting.

Vomiting was present in fifty-seven of the sixty cases. Two of the cases complained of vomiting in the absence of pain, but in no case were both pain and vomiting absent. The vomitus varied, of course, in amount; and one reads of belchings, spittings up, vomiting the last meal taken, or vomiting enormous amounts typical of cases of great dilatation.

Fifteen, or a quarter of the sixty cases, gave a history which might suggest that there had been at some time a distinct *Hemorrhage* from the stomach; only three, however, gave a clear history of frequent vomiting of blood. One case also passed stools suggestive of gastric or duodenal ulcer. A consideration of this one symptom of hemorrhage alone shows that a considerable number of these cases of gastric dilatation would undoubtedly to-day be further analyzed and put into the group of cases in which the dilatation was due either to ulcer or malignant disease.

The *Analyses* of gastric contents as given in the records are not satisfactory. Indeed, one would scarcely expect satisfactory accounts, from our present point of view, in cases running back ten or fifteen years. As we come down towards the present date, however, the analyses are found more accurate, but apparently no more final for the establishment of diagnosis. This criticism of the records is equally true of all manner of cases recorded in former years, and the very fact that in all departments of clinical research our present observations are better than those former ones indicates merely the gratifying fact that we know more than we used to know. The signs "splashing" and "visible peristalsis" are seldom recorded in the early records, although they must have existed. Their significance was apparently disregarded or overlooked.

The *Treatment* of all these cases need not be entered into at length; it was what the physical examination and analyses obviously suggested. The patients were put to bed and lavage was commonly employed, being used in forty-four out of the sixty cases. Most of the individuals were given such tonics as nux vomica, capsicum, light wines, strychnine, and iron. In suitable cases a full diet was employed, in others a dry nitrogenous diet, and in others still, a liquid diet. It is interesting to note that of all the sixty cases, five only were given HCl regularly, and two only were fed upon nutrient enemata.

In all these cases cathartics were employed, — such as Carlsbad salts, aloes, strychnine, belladonna, cascara.

Such in brief outline is a summary of my notes upon the sixty cases as a whole. Let us now consider in more detail those cases which died or recovered, and see if in any way such facts as we have are significant.

Seven cases *recovered* and after several years report themselves as well; two of them are women, five are men. The first and most striking fact about all these is that the recoveries took place in persons in middle life who had been many years dyspeptics, — their periods of invalidism running from five to forty years individually, an important fact for the consideration of those enthusiasts who are urging indiscriminate and immediate operation on all cases of chronic dyspepsia.

The *Dead:* Of the sixty cases, twenty-nine (48.3 per cent) are reported dead, and the causes of this large number of deaths are the subject of most serious importance in this inquiry. We are constantly being told, and with reason, that the greatest danger of long continued stomach disease, after early life, is cancer, — the probability of malignant disease developing on the site of ulcer. After most careful inquiry it appears that in fifteen, or over fifty per cent, of these twenty-nine deaths, cancer was assigned as the cause of death. Our figures are suggestive either way, but prove nothing either way. Of the fifteen deaths from cancer, six followed a history of many years invalidism. These six patients had had stomach symptoms for five, seven, nine, ten, twelve, twenty, and "many" years; they sought relief at the hospital as a last resort, and most of them died a few months after their entrance. The probability, of course, is that the above stated contention is sound, and that in these cases cancer had been implanted upon long standing non-malignant disease.

In the remaining nine cases of death from cancer the disease ran a short course from the initial symptoms to the end — the average duration being seventeen months. The shortest case is recorded as four months in all, and the longest as thirty-nine months. These figures dealing with the duration of cancer correspond fairly well with those of von Mikulicz, Moynihan, and other writers.

The causes of death in the remaining fourteen persons, of whom cancer is not reported, are "starvation;" although for a certain proportion one *suspects* cancer, the presence of which was not disproved, from lack of autopsy.

For the cancer cases one final note is interesting; namely, that with two exceptions all died within nine months after leaving the hospital, no matter what the duration of the disease may have been before entrance. The two exceptions must have developed their cancers after they left the hospital, for their deaths are recorded in three years and five years subsequent to the date of hospital discharge.

Of the fourteen cases against whom the diagnosis of cancer cannot be written, eleven died within a year after leaving the hospital. Lack of proper returns and autopsy records leave us without definite conclusions in regard to these cases, but we must assume that with many of them cancer was the cause of death. Eleven of these cases were of short duration after their discharge, and had been ill previously for periods varying from four months to twenty-three years.

Three of the non-malignant cases lived six, five, and six years after their discharge, and died eventually of "stomach trouble."

To put our facts in other words: of the *twenty-nine* fatal cases, twenty were *short cases*, ill but a few months before entering the hospital, and dead a few months after leaving. Nine were *long* cases; and of the *long* cases four died of cancer soon after coming under observation; two died of cancer several years after being studied at the hospital; and three died of wasting gastric disease other than cancer.

The figures may be juggled in many another interesting fashion, but nothing is proved beyond the first obvious fact that nearly fifty per cent of these cases of gastrectasis died, and that about half the deaths were due to cancer. These cases speak eloquently as to the difficulties to be encountered even in hospital work of making a full and accurate diagnosis.

Nineteen of our cases have been found worse or *Unimproved* since leaving the hospital, and many of them are so seriously ill that we must expect them shortly to be numbered with the dead; eleven of them are men and nine of them are women. Their ages are unimportant, but we may note that they averaged at entrance forty-three years; the youngest being a man of twenty-eight, the eldest a man of sixty-four. And the duration of their invalidism varies all the way from one to twenty-eight years, the average being 10.7 years.

Most of them, however, give histories of long continued dyspepsia, either before entering or since leaving the hospital, so that it is fair to state that in very few, if any, of these cases are we at present dealing with malignant disease. The essential symptoms have been epigastric pain after eating, which is present in all of the nineteen, and occasional vomiting, which is present *in seventeen of the nineteen.* The symptom of ancient hemorrhage has been present in but six of the cases, and such hemorrhages were so long ago recorded that a positive diagnosis of gastric ulcer cannot very well be made. The presence or absence of HCl in these cases is interesting. It was present in sixteen of the cases and persistently absent in three; yet those three cases obviously had no cancer, for they have continued living on feebly for nine and ten years since leaving the hospital, — indeed one of them has been an invalid fifteen years, the second thirty-three years, and the third thirty-four years. In all of the nineteen unimproved cases there was greatly delayed motility with a gastric capacity considerably increased. They have gone on living many years since leaving the hospital, but all are hopeless invalids, dependent on others for their support. It is a depressing series of biographies.

Five cases of our sixty are reported as *Improved.* Though not to be placed in the class "well," they approximate that class, and may be considered in the same connection. Two were females and three were males, and their ages vary widely; the youngest being a woman of twenty-two, the eldest being a woman of fifty-four, at entrance.

Taking these five cases in some detail we note that

Case 1. — Was fifty-four years old at her entrance, fifteen years ago, and is now fairly comfortable at the age of sixty-nine. She had been ill twenty-one years when first seen at the hospital, so that now, in her old age, she has been a dyspeptic for thirty-six years. Her symptoms have been occasional epigastric pain after eating, and occasional vomiting. It is recorded that some twenty years ago she vomited blood twice, and the presumption is that she has a slight pyloric obstruction due to a healed ulcer. At the hospital the stomach contents contained free HCl. She was treated by lavage, cathartics, tonics, and nutrient enemata, and be it noted that this case and the next are the only ones in our list of sixty of whom it is recorded that they were treated by nutrient enemata. This patient continues the use of the stomach tube at home and enjoys a fairly comfortable existence. A good example of what may be expected in moderate stenosis of the pylorus under fairly favorable circumstances.

Case 2. — Was a man thirty-nine years old who had been acutely dyspeptic for one year. He too had had and has epigastric pain, occasional vomiting, and has a record of one hemorrhage about nine years ago, before entrance, and he, too, doubtless has a slight pyloric obstruction due to a healed ulcer. No free HCl was found present; there was abdominal splashing and he was treated by lavage, was given HCl and fed by nutrient enemata. He reports himself as fairly comfortable.

Case 3. — Was a young woman of twenty-two who had been a dyspeptic for eighteen months, with epigastric pain several hours after eating and occasional attacks of vomiting. At one time, shortly before entrance, she vomited blood; HCl was present; she was treated by lavage, was discharged after two weeks and reports herself as fairly comfortable so long as she uses the stomach tube.

Case 4. — Was a man of thirty-nine who had had symptoms for twelve years. Now, fourteen years since his discharge, he looks back on twenty-six years of dyspepsia. He is thin, — twenty pounds below his normal, with occasional attacks of pain and vomiting; HCl was present in his case; he was treated and continues to treat himself by lavage.

Case 5. — A man of fifty-two at entrance, had symptoms of comparatively short duration, — three years before entrance and two years since. He has lost thirty pounds in weight and has the usual symptoms of occasional pain after eating and occasional vomiting; HCl was present in his case and he continues fairly comfortable with the use of lavage.

All of the above five cases had dilatation of moderate extent with a gastric capacity ranging from forty to eighty ounces, and delayed motility; indeed, except for the disparity in age they seem quite similar.

The lesson apparently to be drawn from this is, that patients with mild degrees of dyspepsia, in whom there are healed ulcers with some pyloric obstruction, may be kept fairly comfortable by the continued use of lavage, which prevents accumulations, and consequent fermentation, but cannot be made completely well while the obstruction, mechanical or functional, with its consequent dilatation and malnutrition persists. However, we must not forget that such an existence to many persons is preferable to the thought of undergoing an operation.

The *Well:* As with the class of "improved," the "well" occupy but a small space in our list. Seven persons out of sixty report themselves well. When we come to study the figures we find little that is significant. The ages of these patients on entrance varied from twenty-nine to fifty-seven; five of them were men, two were women; and while the two women had been ill twenty and fifteen years, respectively, the men had been ill for from six months to forty years; in no case was there a striking loss of weight, except in that of a man of forty-two who had lost forty pounds. In brief detail the records are as follows:

Case 1.—Was a man of fifty-seven, who had been ill forty years and lost five pounds; he was a carpenter and there was some suspicion of lead colic about him; during this long period he had had frequent attacks of gnawing epigastric pain relieved by food, sometimes vomiting would relieve the pain, and he had vomited as much as two quarts at a time; he was constipated and flatulent, he was thin and neurotic. The lower border of his stomach was four inches below the umbilicus, there was a residue of eight ounces thin undigested food, not foul; there was abundance of free HCl and no lactic acid. The man was put on a dry nitrogenous diet with bicarbonate of soda, iron, and gentian; after six weeks he was discharged well. For the past nine years he has remained well.

Case 2. — Was that of a man very different from the last; he was thirty-five years old and had had symptoms for three years only. At the hospital they thought he might have cancer, but that was eleven years ago and he is still living. For three years he had debility, poor appetite, and epigastric pain coming on half an hour after food. He was an emaciated man and there was abdominal splashing. At the hospital they fed him up and gave him HCl. His stomach was dilated to the umbilicus. In two weeks he went home well. He has been well ever since.

Case 3. — Was a good deal more serious; it was that of a man forty-two years old, whose stomach reached three inches below the umbilicus with a capacity of sixty ounces; HCl was present and no lactic acid. For many years he had had occasional vomiting of about fifty ounces at a time. He had lost forty pounds. At the hospital they washed him out and fed him up, and at the end of two weeks he went home, taking with him a stomach tube, since unused. That was six years ago and he has been well ever since.

Case 4. — Was that of an emaciated middle-aged man, who had been vomiting occasionally for ten years, and usually at midnight; he used quite frequently to have pain after food, there was some ptosis of the stomach and the dilatation extended four inches below the umbilicus. A residuum of five ounces was expressed, and much free HCl was present, as well as butyric and lactic acids.

It is evident, from the tone of the record, that this was regarded as a rather ugly case; but they gave him Carlsbad salts, washed his stomach out, sent him home with a tube, and he has been well ever since. That was four years ago.

Case 5. — Also looked unpromising; it was that of a man forty-four years old, who had epigastric burning, and dull aching two or three hours after food for many years. He had lost twelve pounds. The pain was evidently relieved by food, but came on again later, and often he used to vomit up a pint or more. He, too, had ptosis of the stomach and splashing, with the greater curvature two inches below the umbilicus. His gastric capacity was fifty-three ounces, and free HCl was present.

They gave him a milk diet, salts, bismuth and bicarbonate of soda, with daily lavage. He went home well and is well to-day after four years.

Case 6. — Was that of a young woman twenty-nine years old, who had been a dyspeptic for twenty years, and had vomited mucus and food at varying intervals during that period. There had never been any significant pain, but she was emaciated, with a stomach four inches below the umbilicus; without HCl and with lactic acid present.

She was put on a full diet, after three days of which HCl was found. After three days of such treatment, and with lavage, she left the hospital with a stomach tube and slightly relieved.

Here's a quotation from her letter written twelve years after leaving the hospital. It is instructive and somewhat entertaining: "All of the symptoms returned after leaving the hospital, and for three or four years I was very ill indeed, and finally was persuaded to go to Dr. F——; after treating me for about ten months he succeeded in curing me almost entirely. I gained in that time about twenty pounds and have gained almost steadily since (*sic*, for eight years!).

"Dr. F—— does not believe in washing the stomach. I am sure that the thing which did me the most good was teaching me how to live. I can now eat almost anything, and, unless I am indiscreet, rarely have return of the old trouble."

Case 7. — Was that of a widow of thirty-eight, with a history of fifteen years dyspepsia. The record notes the fact that she was a neurasthenic with a slightly dilated stomach. During these fifteen years she had had occasional attacks of vomiting, but no hematemesis; she was constipated, thin, and excitable; she spent three weeks in the hospital, being fed up and being given tonics. Then she was discharged "relieved." A month later she reëntered the hospital to stay there two months under the same treatment, and was then discharged well. She had no gastric lavage.

Eleven years have elapsed and she reports herself in excellent health.

Of these seven persons who recovered and have remained well, there is nothing especially in the history to distinguish them from the persons who died or the persons who continue dyspeptics. All appeared unfavorable cases for treatment; none of the seven had hemorrhages, six had vomiting; and in every case there was either vomiting or pain or both; each one had a dilated stomach. They are shining examples of what may be done "medically" with unpromising cases.

In this "well" class again the investigation of gastric contents determined nothing except that delayed motility was shown; four cases had HCl, three of them had it not; two of the cases showed lactic acid and five of them showed none; four of the cases, those with most considerable dilatation, were treated by lavage; three of them, those with slight dilatation and of the neurasthenic type, were not so treated. All of the cases were in middle age or just about entering upon that period of life; and all of them are still living, well advanced in middle age or old age.

Just what may be the causes of dilatation in these "well" cases is not apparent, but certain it is that they have been fortunate enough to pass through long periods of gastric disease without developing cancer and that they are now well; — these seven out of sixty.

In resumé I may say, as already stated, that I have been considering a series of cases in which the diagnosis has been made of a prominent symptom which has several important etiological causes. For one reason or other best known to the clinicians under whose eyes these cases came during the past fifteen years, no definite attempt was made to separate these cases into their etiological groups for diagnostic purposes. This is not surprising when we remember the general disfavor with which "dyspeptics" have been treated in years past, — they have received scant attention in too many instances. In the light of our present knowledge and with the present enthusiasm for stomach work, it seems more than probable that this diagnosis — gastrectasis — would not be the only one made to-day in many of these cases. The series shows distinctly that a goodly number would be regarded as of mechanical obstruction, probably of benign origin. The difficulties in the way of diagnosis are illustrated by the resulting cures in some of the most unfavorable cases, and in the rapidly following deaths in others presenting the mildest symptoms, as well as symptoms of the shortest duration. It must, however, be held firmly in mind that while many of our present diagnostic procedures have been known for years past, their complete application in a practical logical manner has been a matter of a few years only. The surgeon who is given to criticising medical diagnosis and treatment should remember also that he must be as lenient in his judgment of past medical diagnosis and treatment as he desires internists to be when he asks them to blot out from their remembrance the statistics of all gastric surgery done before the year 1904. Certainly a number of the above cases of dilatation would apparently have been benefited by an operation for the relief of the mechanical obstructions which evidently gave rise to the symptoms, and the point is to be insisted upon that after all possible attempts have been made to reach a clear understanding of the causes of gastrectasis, and after the adoption of suitable therapeutic measures without beneficial results, then operative measures are to be considered and a surgical consultation called.

FLIES AND TUBERCULOSIS.*

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PREVIOUS OBSERVATIONS.

Spillman and Haushalter[1] found tubercle bacilli both in the intestinal contents and the excreta of flies in a hospital ward.

Hofmann[2] demonstrated tubercle bacilli in the intestinal contents in four of six flies caught in the room of a recently fatal case of phthisis; fly specks scraped from different parts of the room also showed tubercle bacilli. Flies were fed on tubercular sputum and the presence of tubercle bacilli observed in their excreta. Of three guinea-pigs inoculated with the intestines of these flies only one developed tuberculosis. Inoculation of specks which had dried for six to eight weeks gave a negative result.

Celli[3] states without details that Alessi, under his direction, fed flies on tubercular sputum. Two rabbits developed tuberculosis after inoculation into the anterior chamber of the eye with the dejecta of these flies.

Hayward[4] has recently confirmed the presence of virulent tubercle bacilli in the excreta of flies fed on tubercular sputum.

Thus far, therefore, it may be considered established that tubercle bacilli may appear in the stools of flies which have recently ingested tubercular sputum. Celli and Hayward obtained tuberculosis of experimental animals by inoculation of fresh dejecta, while Hofmann succeeded in one of three injections with the intestines and failed with specks which had dried for six to eight weeks.

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*Reprinted from the Boston Medical and Surgical Journal, Vol. cli, No. 24, pp. 651–654, Dec. 15, 1904.

[1] Spillman and Haushalter. Dissemination du bacille de la tuberculose par les mouches. Comp. rend. 1887, t. cv, No. 7, pp. 352, 353.

[2] Hofmann. Die Gefahr der Weiterverbreitung der Tuberculose durch unsere Hausfliege. Jahresb. d. Gesellsch. f. Nat. U. Heil. in Dresd., 1887–8, pp. 145–147.

[3] Celli. Transmissibilita dei germi patogeni mediante le dejectione delle mosche Bull. d. Soc. Lancisiana d. Osped. di Roma., 1888, Fasc. 1, p. 1 (quoted from Nuttall. The Johns Hopkins Hosp. Rep., Vol. viii, 1900).

[4] Hayward. The fly as a carrier of tuberculous infection. N.Y. Med. Journal and Phila. Med. Journal, Oct. 1, 1904.

PERSONAL OBSERVATIONS.

I. Flies and Tubercular Sputum under Artificial Conditions.

In August, 1904, my interest was aroused in the possible dissemination of tubercle bacilli through flies by their feeding on sputum under examination.

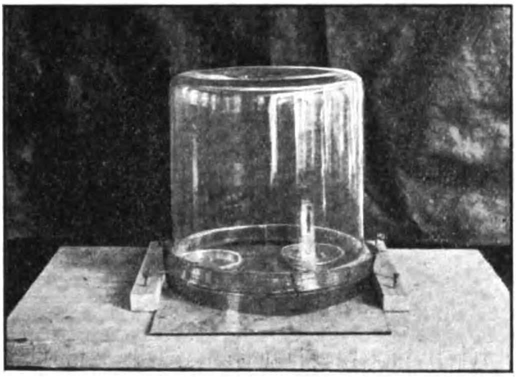

FIG. 1. — Glass jar for confining flies.

A. Feeding experiment: apparatus. — Three glass jars were inverted over a piece of window glass. They were raised three-quarters of an inch above the glass plate and the intervening space closed with fine wire netting.

Flies and tubercular sputum. — Thirty house flies were confined in one of the glass jars (Fig. 1). Many clean cover-glasses and a small glass dish containing sputum with about ten tubercle bacilli to each microscopic field were placed on the bottom of the cage. The flies were allowed to feed on this sputum between Aug. 10 and 13, 1904.

Death of the flies. — Within three days, twenty-six of the flies were dead. The four remaining flies were very inactive.

Control I.: Six flies were confined in a second similar jar and fed on non-tubercular sputum. They were all found dead on the bottom of the cage within two days.

Control II.: Six flies were confined in a third similar jar and fed on water, sugar, and meat. Two of these died within two days. The remaining four were still alive after one week, when the experiment was discontinued.

The short duration of the life of the flies fed on tubercular sputum is not due, therefore, to tubercle bacilli, but to some other constituent of the sputum.

Tubercle bacilli in the fly. — Paraffin sections were made from many of the flies fed on tubercular sputum. Tubercle bacilli were found in the intestinal contents of all. No invasion of other parts of the body could be determined.

Tubercle bacilli in the specks: time of appearance. — Examination of the cover-glasses placed on the bottom of the cage showed that the bacilli appear in the stools within at least eighteen hours after the ingestion of the tubercular sputum.

Number of tubercle bacilli disseminated. — Examination of many specks on the cover-glasses showed that the number of bacilli in each microscopic field had increased from about ten in the original sputum to one hundred and fifty in the specks. Each speck contained from 3,000 to 5,000 bacilli. About 2,000 specks had been deposited by the thirty flies within three days, thus from 6,000,000 to 10,000,000 tubercle bacilli had been transferred from the sputum to the inner sides of the cage during this period.

Virulence of the tubercle bacilli in the specks. — At the completion of the feeding experiments the glass jar containing the specks was placed on a table in the middle of an unused room of the laboratory. This room (floor, 18 x 18; height, 20 feet) is lighted by two windows with a northern exposure. The direct rays of the sun do not reach it at any season of the year. A board three feet high was placed between the glass jar and the windows (Fig. 2) to protect the jar from strong diffuse daylight.

Guinea-pigs were each inoculated with one hundred fly specks scraped from the cage at intervals of one, eight, fifteen, twenty-eight, and fifty-five days. The first inoculation was made subcutaneously, the others into the peritoneal cavity. The animals were killed after five to seven weeks. Tuberculosis was produced by the inoculated material in the first three animals, showing that virulent tubercle bacilli were present in the specks for at least fifteen days. The pigs were negative after this interval.

The pig inoculated with the specks which had dried for only one day showed generalized tuberculosis. A gradual diminution in the extent of the process was observed. The pig inoculated with specks which had dried for fifteen days presented large isolated tubercular lesions of the spleen and of two lymph glands: one in the gastro-hepatic omentum, the other in the anterior mediastinum. Tubercle bacilli were demonstrated in the lesions.

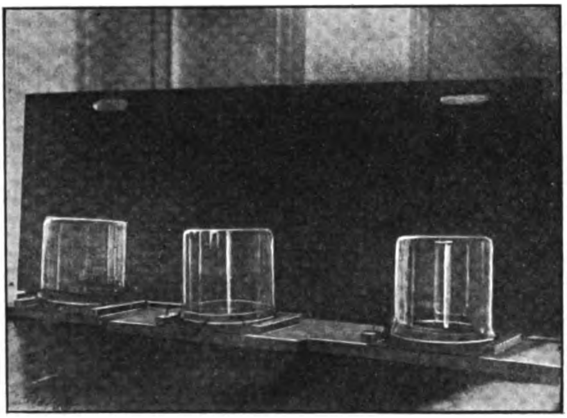

FIG. 2.—The relation of the specks to the lighting of room. Drying experiment.

The above experiment is thought to show that fly specks contaminated by tubercle bacilli may be a source of danger by direct transfer to the human subject, as in the ingestion of infected food, for at least fifteen days after their deposit, if exposed only to diffuse daylight in the interior of a room.

Previous observers have shown that tuberculosis can be produced in animals by feeding them on infected material. As this has been already established (see below) it was not thought necessary to feed the infected fly specks to animals, but merely to determine their virulence and its duration.

The far greater frequence of tuberculosis of the lungs in the human subject and a mass of experimental data (Cornet[1]) indicate that the usual contagion of tuberculosis is not by the ingestion of infected food, but by the drying and distribution as dust of infected material through the air.

It was next of interest, therefore, to try to determine whether infected fly specks play any part in this indirect and more common infection by contamination of the surrounding air.

B. Inhalation experiment: apparatus. — A glass cylinder (18 × 2 inches) was closed at either end by wire netting, tacked to a rim of cork. One end of this tube was closely fitted to a hole in the side of a wooden box. The inner opening of this hole into the box was also closed by wire netting, leaving a space of one-half inch between this and the netting closing the end of the glass cylinder. The box (8¾ × 9 × 12 inches) was closely fitted with a glass cover and its sides sealed by pasting paper about it. A stiff rubber tube connected with a water vacuum apparatus[2] (Eimer and Amend) was led through the side of the box opposite the entrance of the glass cylinder (Fig. 3). The air in the box was exhausted by this means so that a constant slow current passed through the cylinder into the box and out the rubber tube at the other side. The direction of the air current was readily shown by blowing smoke toward the free end of the glass cylinder. An attempt was made merely to keep a gentle flow of air through the cylinder into the box.

Twenty-three flies were confined in the glass cylinder with tubercular sputum. They deposited, between August 17 and 19, a large number of specks on the inner surface of the tube. During these two days all but four of the flies had died. These survived only twenty-four hours longer.

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[1] Cornet. Spec. path. u. Ther. Nothnagel. xiv, Bd. 2. II. Abth.

[2] Suggested by J. H. Wright.

On August 19 a young and healthy guinea-pig was placed in the box and a slow current of air drawn through the glass cylinder into the box by means of the vacuum apparatus. The pig was confined here for eight days. The apparatus was kept in the same room and under the same conditions as in the feeding experiment (Experiment A).

Twelve weeks were allowed to elapse before this animal was killed. At the autopsy not a trace of tuberculosis could be found in any part of the body. Microscopic examination of sections from different parts of the lungs revealed no lesions.

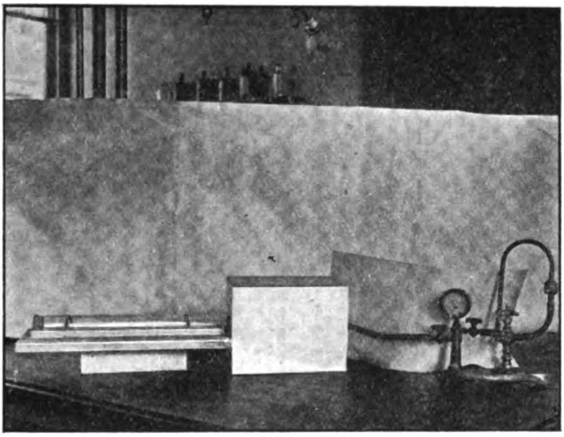

FIG. 3. — Inhalation experiment. Pig confined in box for eight days.

Cornet[1] has shown that guinea-pigs can readily be infected by dust from tubercular material. Of forty-eight guinea-pigs exposed in a room to dust shaken from a contaminated carpet, tuberculosis was produced in forty-seven.

From the above experiment (Experiment B) there is no evidence of the spontaneous liberation of tubercle bacilli from the fly specks, even when swept by a gentle current of air. It is probable, however, that when mechanically disturbed infection of the air would occur as in Cornet's carpet experiment.

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[1] Cornet. *l. c.*, p. 61.

II. Flies and Tubercular Material under Natural Conditions.

I have frequently observed the eagerness with which flies feed on sputum even when other food is accessible. Their dejecta frequently soil the walls and cloud the windows of unscreened rooms. During the fly season I have counted many thousand fly specks on windows which are frequently washed. In their migration from one kind of food to another flies must deposit great numbers of specks on food. If they eat of tubercular material and later alight on foodstuffs intended for human ingestion, they may deposit on them great numbers of tubercle bacilli. If these infected specks are unexposed to sunlight or strong diffuse daylight, they may maintain their virulence, as the above experiment (Experiment A) has shown, for at least fifteen days. If the specks are exposed to the direct rays of the sun they probably lose their virulence much more quickly. Mitchell and Crouch,[1] for example, found that tubercular sputum, placed in direct sunlight failed to infect guinea-pigs after thirty-five hours. If preserved in the dark they may remain infective for a much longer period than fifteen days.

Tuberculosis may readily be produced in animals experimentally, by feeding them on food infected with tubercle bacilli (Baumgarten,[2] Fischer,[3] Dobroklonski[4]). In these animals the tubercular lesions are in the cervical lymph glands, the intestines, the mesenteric glands, the liver and more rarely the lungs (Baumgarten[5]). By analogy, primary tuberculosis of the intestines or the mesenteric lymph glands in man may be regarded as due to the ingestion of infected food. Many such cases have been reported among others by Demme,[6] Ollivier,[7] and Wyss.[8] In such infections I have no doubt that flies play a part.

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[1] Mitchell and Crouch. Journ. of Path. and Bact., vi, p. 14.

[2] Baumgarten. Cent. f. kl. med., 1884, No. 2.

[3] Fischer. Archiv. f. exp. Path. u. Pharm., Bd. xx.

[4] Dobroklonski. Archiv. f. m. exp., 1890, p. 253.

[5] Baumgarten. *l. c.*

[6] Demme. Quoted from Cornet, *l. c.*, p. 100.

[7] Ollivier. Quoted from Cornet, *l. c.*, p. 100.

[8] Wyss. Quoted from Cornet, *l. c.*, p. 100.

Cornet readily produced tuberculosis of the lungs and bronchial glands in guinea-pigs by dust from his infected carpet. If undisturbed, spontaneous liberation of tubercle bacilli from fly specks is unlikely even when they are exposed to a current of air (Experiment B). If mechanically agitated, however, aerial infection probably occurs, as with dried tubercular sputum.

CONCLUSIONS.

1. Flies may ingest tubercular sputum and excrete tubercle bacilli, the virulence of which may last for at least fifteen days.

2. The danger of human infection from tubercular fly specks is by the ingestion of the specks on food. Spontaneous liberation of tubercle bacilli from fly specks is unlikely (Experiment B). If mechanically disturbed, infection of the surrounding air may occur.

As a corollary to these conclusions, it is suggested that

3. Tubercular material (sputum, pus from discharging sinuses, fecal matter from patients with intestinal tuberculosis, etc.) should be carefully protected from flies lest they act as disseminators of the tubercle bacilli.

4. During the fly season greater attention should be paid to the screening of rooms and hospital wards containing patients with tuberculosis and laboratories where tubercular material is examined.

5. As these precautions would not eliminate fly infection by patients at large, foodstuffs should be protected from flies who may already have ingested tubercular material.

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SELECTED PAPERS BY THE STAFF

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VOLUME I. NUMBER 3

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THE NEW CLASSIFICATION OF BENIGN TUMORS OF THE BREAST, WITH AN ILLUSTRATIVE CASE.*

BY J. COLLINS WARREN, M.D., *of Boston.*

The following case is reported as illustrative of the two principal types of benign tumors, both conditions occurring in the same breast, and also to show what can be accomplished in the treatment of non-malignant growths by conservative surgery, with the hope that many a breast that otherwise would be amputated may be saved. The nomenclature here employed has been adopted as the result of a study of 758 cases of tumors of the breast,[1] and which was embodied in the "Oration in Surgery" read by me at the annual meeting of the American Medical Association in 1905.[2]

As was pointed out in that paper, the old classification of tumors and diseases of the breast is extremely confusing, the pathologists in no two centers of learning using the same term to describe a given condition, and in comparing the classifications and terms used by the pathologists on one hand and the clinician on the other, the confusion is, if possible, worse. The classification that was brought forward and embodied in the paper referred to was an attempt on my part, while recognizing the claims of the pathologists, to make one that would be pathologically correct and at the same time be practical and adaptable to clinical use.

The breast differs from most other glands in the changes that it undergoes, — first at puberty, then during lactation and, lastly, at the menopause, — that is, it is for most of the time in a condition that may be termed one of unstable equilibrium, and the relation of its component parts differs markedly at different periods of life. It is also composed of two kinds of tissue, — fibrous and epithelial, — the relative proportions of each varying greatly at these different periods of life, but both of which enter into any tumor formation in the breast. In a classification of benign breast tumors it is necessary, therefore, to take both of these tissues into consideration, and for this reason the term applied by Ribbert of "fibro-epithelial tumors" has been adopted. In most of these tumors the fibrous element predominates, but in a few the epithelium plays the most important rôle. While this is a perfectly satisfactory term for the group of non-malignant breast tumors, it cannot be applied to that diffuse condition occurring at the menopause, which is often called "chronic mastitis," — an absolutely misleading term. Normally, at this period of life the breast undergoes involution, with an increase in the fibrous tissue and the formation of some small retention cysts caused by pressure on the ducts. If this stage is prolonged, or accompanied by changes greater than would be normally expected, I have applied to it the term of "abnormal involution." This is synonymous with the so-called "chronic cystic diseases" of the breast, "chronic mastitis," "adenocele," etc. The condition is in reality a hyperplasia of one or both tissues which compose the breast to a greater or less extent. It is a diffuse process, and should not be confounded with the distinct tumor formations previously mentioned.

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*Reprinted from the Boston Medical and Surgical Journal, Vol. clv, No. 20, pp. 566-568, Nov. 15, 1906.

[1] Collected and analyzed by Drs. R. B. Greenough and C. C. Simmons.

[2] Jour. Am. Med. Asso., July 15, 1905.

The following is the classification adopted in the previous article, the non-indigenous growths, inflammatory conditions, and carcinoma being omitted.

Fibro-Epithelial Tumors.

(1) Fibrous type.
  1. Periductal fibroma.
  2. Periductal myxoma.
  3. Periductal sarcoma.

(2) Epithelial type (cyst adenoma).
  1. Fibro-cyst adenoma.
  2. Papillary-cyst adenoma.

Hyperplasia:
  1. Diffuse hypertrophy.
  2. Abnormal involution.
    Cystic.
    Proliferative.

Under the fibro-epithelial tumors the periductal fibromata are those tumors often termed simple fibromata or intra-canalicular-papillary fibromata, the adjective periductal being applied to designate their point of origin, — the periductal fibrous tissue, a tissue characteristic of the period of puberty. The periductal myxomata are myxomatous tumors originating in the same manner, and are comparatively rare. Most of them are in reality only edematous fibromata. The periductal sarcoma arises in the same manner, and appears as a very cellular fibroma. It is for all practical purposes non-malignant, and is distinct from the non-indigenous sarcomata of the breast.

In the epithelial group of fibrous tumors, the term fibro-cyst adenoma is applied to that rare tumor which is, in gross, similar to the periductal fibroma, but in which microscopically the epithelial proliferation, as shown by the large number of glandlike structures, is the striking feature. The papillary-cyst adenomata are those cystic tumors filled with papillary or glandular ingrowths of fibrous tissue covered with epithelium, and usually contain bloody fluid. They are commonly seen under the nipple, and are accompanied by a bloody discharge. They are identical with the "duct cancer," "villous papilloma" and "adenoma" of certain authors.

Benign tumors of the fibrous type are found in young women; that is, before they are thirty-five years of age. Benign tumors of the epithelial type are found later on in life; that is, between middle life and old age.

The hyperplasias in distinction to the fibro-epithelial tumors are diffuse processes. Of this group there are two varieties, — one diffuse hypertrophy, being practically a negligible quantity. The name is applied to the enormous hypertrophy of the breast sometimes seen at puberty or to that seen during pregnancy, and clinically the cases are of little interest other than as a curiosity.

The other division of hyperplasia, to which I have applied the name "abnormal involution," comprises that large group of diseases of the breast occurring in women at about the menopause, and characterized chiefly by increase in the fibrous tissue and cyst formation. These diseases have been attributed to inflammatory processes by some, regarded as new growths by others, while still others, and among them the greater number of recent observers, consider them involution changes. In this group the fibrous tissue is increased, while the ducts are dilated. The change is usually mainly fibrous, but if there is much epithelial increase the ducts may be filled with epithelial cells. In the more advanced forms, which are apt to progress into carcinoma, this epithelium may have a papillary or even an adenomatous arrangement within the ducts.

Case. May, 1906. The patient, a woman, thirty-four years old, had been married one year, but had had no children. The family and previous history were not remarkable. Eight years previous, that is, when twenty-six years of age, she noticed a lump in the right breast which had increased slowly in size for a time, but had not changed for some years before consultation. The right breast had, since she was twenty-two years of age, been smaller than the left. She had had no pain at any time. During the last two years there was a slight watery discharge from the nipple. The catamenia were regular and normal, and were not accompanied by symptoms in the growth.

Examination showed a fairly well-developed and nourished woman. In the lower inner quadrant of the right breast, which was slightly fuller than the left, was a hard tumor, the size of a small English walnut. This was not adherent to either the skin or muscle, and was not tender. The rest of the breast on palpation seemed to be slightly fuller and to contain more breast tissue than the other. The nipple was normal and examination failed to demonstrate any glands in the axilla.

The operation performed is that to which I have given the name "Plastic resection of the mammary gland." Recovery from the operation was uneventful. The stitches were removed on the sixth day, and the patient discharged soon after, wearing a breast bandage.

Pathological report, by Dr. C. C. Simmons. — The specimen was received in two portions. One consisted of a roughly triangular piece of breast tissue 1.5 cm. in breadth at the base and 5 cm. in length. On one surface this was covered by a moderately distinct fibrous layer, probably representing the fascia under the breast.

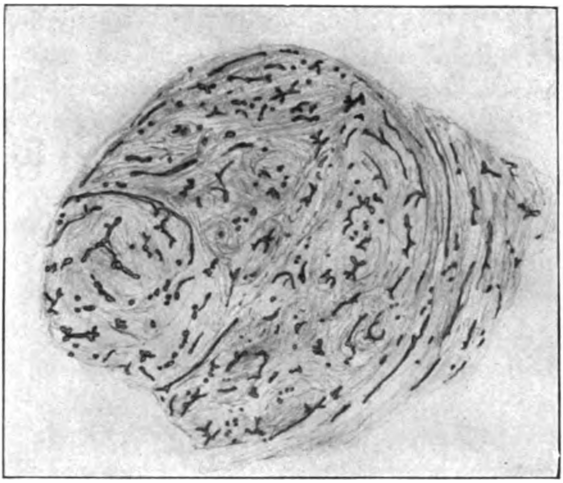

FIG. 1. Periductal fibroma. Characterized by an overgrowth of the periductal fibrous tissue with but secondary changes in the epithelial elements.

Near the apex on the upper surface were several hard, rounded tumors varying up to 1 cm. in diameter. On section these were distinctly encapsulated, firm, of a grayish white color and traversed by numerous clefts. The remaining portions of this fragment were composed of normal appearing breast tissue.

The other portion of the specimen was irregular in shape, roughly 2 cm. in diameter, and consisted of fibrous tissue in which were many small tumor-like areas ½ cm. in diameter or less. On section some of the tumors were similar to those of the large piece, while others presented numerous clefts, and in places there seemed to be distinct papillary projections.

Microscopic examination of the hard tumors from the larger piece showed encapsulated masses of dense fibrous tissue, which in places had undergone hyaline degeneration, traversed by numerous short branching clefts. (Fig. 1.) These clefts were lined with one or more layers of epithelium, and in their neighborhood the fibrous tissue was much less dense than elsewhere.

The characteristic of these tumors was the fibrous tissue, the epithelial elements having a distinctly secondary place.

Microscopic examination of the smaller piece showed an entirely different process. The ducts were dilated and lined with several layers of epithelium, which in some instances had a papillary or even adenomatous arrangement. Certain of these ducts contained branching fibrous papillary projections, covered with one or more layers of epithelium, and formed distinct, small tumors. (Fig. 2.) In this specimen, therefore, the changes were primarily epithelial in character.

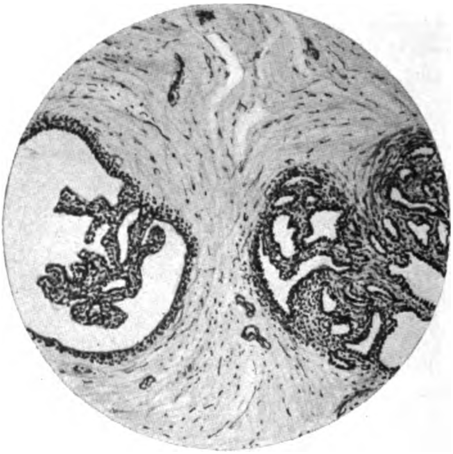

FIG. 2. Papillary-cyst adenoma. From beneath the nipple. The ducts are dilated and filled with fibrous papillary projections covered with epithelium. The changes here are mainly epithelial.

Diagnosis. — Multiple periductal fibroma. Papillary-cyst adenoma. Abnormal involution with marked epithelial hyperplasia.

We have a rather unusual combination in this case, but one which illustrates well the two types of benign tumor of the breast, viz., the fibrous and the glandular. It also serves to illustrate the point that there is no well-defined line of separation between them, and that we cannot, therefore, group them separately. The term "true adenoma," as applied to tumor formation in the breast, must, therefore, disappear, and we must be content to recognize the fact that a small proportion of the benign tumors of the breast (fibro-epithelial tumors) are of a marked epithelial type, and have a right to be designated as belonging to the adenoma class (cyst adenoma). The fact that in benign tumors of the breast the fibrous tissue may sometimes predominate and that at other times the epithelial structures are the most characteristic feature, is one that we must also remember when considering the prognosis of a given case. For when we find so marked an epithelial activity in a tumor, even though it may be classified as benign, we cannot but feel that surgical intervention has been more than justified.

Plastic resection of the mammary gland: This operation consists in a reflection of the breast from below, upwards, in a manner to expose the posterior surface of the gland, and the removal of one or more v-shaped segments of the gland, the apex of the v coinciding with the central point of the circle.

The preliminary incision is longer than that contemplated by Thomas, and runs from the lower inner quadrant along the fold of the breast to the inner border of the axilla. The incision should be carried down deep enough to expose the pectoralis major muscle. The dissection should then be carried along through the loose tissue overlying the pectoralis fascia, while with the left hand the operator lifts the breast upwards and inwards so that the entire posterior surface of the gland is exposed. The tumor can now be exposed by a radiating incision, if desired, or preferably removed entire in the center of a wedge-shaped mass of gland tissue, including the entire thickness of the gland. These fibrous tumors are not easily dissected out, as the capsule is intimately adherent to the adjacent gland tissue. If necessary, the remaining portions of the gland can be explored by radiating incision, but this is usually unnecessary, as the presence of a tumor in the gland can easily be detected by palpation, differing in this respect from the cases of abnormal involution or "cystic disease." The wedge-shaped cavity thus made should be sewed with a double row of catgut sutures, and no silk should be used either for suture or ligature. The gland is now dropped back upon the pectoral fascia and stitched firmly along its outer border. These buried sutures are useful in removing strain upon the surface.

I am in the habit of using silkworm gut for the skin suture.

The cavities of these tumors rarely give rise to sepsis, as they are usually sterile, but in the case of tumors of this character near the nipple, it is well to avoid opening during the operation. If, however, opening such a cavity is unavoidable, the wound should be disinfected before being closed.

The dressing should be held in place by the "empire bandage," a bandage which crosses obliquely in front, and is pinned like a diaper. Each end of this bandage is folded longitudinally in such a way as to produce lateral pressure upon the organ and hold the subcutaneous wounds firmly together. The ends of the bandage are then attached to suspenders crossing over the shoulders.

EXPERIENCE IN THE TREATMENT OF TABES BY CO-ORDINATIVE EXERCISES.*

By E. W. Taylor, M.D., and Edward A. Lindström,

From the Department of Neurology, Massachusetts General Hospital.

Since the publication in English of Frenkel's book on tabetic ataxia a somewhat widespread interest in the method of treatment which he describes has been manifest. It is, however, somewhat extraordinary that a method so easily applicable should not have been even more widely used. The reasons presumably are that in the practice of others than neurologists cases of tabes occur so infrequently that a systematic use of the method has not suggested itself, and also to the fact that even in neurological clinics and in the private practices of those who see many such cases disappointments have come because the method has not been persistently carried out over a long period of time by a person competent to give the required instruction. However this may be, the fact remains that many cases of tabes are neglected until their ataxia has reached so advanced a stage that treatment becomes exceedingly difficult. The object of this communication is simply to call attention to a well-recognized method and, if possible, to demonstrate its feasibility both in private practice and in hospital clinics.

It is not necessary to go into detail regarding the theory of the treatment. This is adequately and completely described in Frenkel's[1] book devoted to the subject. For the benefit of those who may be unfamilar with this book and with the principles involved, we need merely say that the prime object of the treatment is to retrain the lost or damaged co-ordination, which is the underlying condition of the motor disturbances of tabes. This is accomplished by means of exercises beginning with simple movements in a recumbent position and progressing to more complicated ones in the semi-erect and finally in the erect position. The rationality of the procedure may easily be explained to a patient of ordinary intelligence, and under proper guidance there is never difficulty in eliciting his full interest in the educational process. We shall revert to the practical details later.

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* Published in the Boston Medical and Surgical Journal, 1906, clv, p. 699.

[1] Frenkel: The Treatment of Tabetic Ataxia. English translation by Freyberger. P. Blakiston's Son & Co., 1902.

This paper is based upon a conscientious trial of the method advocated by Frenkel, both in the out-patient neurological service at the Massachusetts General Hospital and in private. The general results of the treatment have been most satisfactory. In all cases in which proper time and attention have been given, improvement has been definite and in many instances very marked. We have had under our care approximately thirty patients during the past two years, fairly equally divided between hospital and personal practice. Several of these we report in brief.

Case I. — H. L. A Jew, thirty years old, has been under treatment, with the exception of the summer months, steadily, since February, 1905. At the beginning of treatment he was exceedingly ataxic, in wretched general condition and rapidly approaching the helpless stage. The signs of tabes were all well marked. His interest in the exercises was active from the first and has since become almost a passion with him. The result has been altogether gratifying and he is able now to walk long distances, several miles, with no assistance whatever and with relatively slight evidence of ataxia. This patient has been treated entirely at the Massachusetts General Hospital.

Case II. J. M., forty-eight years old, has been treated at the Massachusetts General Hospital since April, 1905, with similarly gratifying results. He sought relief because he was finding it impossible to continue his work on account of increasing ataxia.

Case III. R., forty-six years old, has been under almost continuous treatment since December, 1904, and shows a similar improvement to the cases already mentioned. He still continues to come to the clinic, and finds no marked difficulty in locomotion.

A very natural difficulty met with in the treatment of these cases at the Out-Patient Department is the failure on their part of faithful attendance. Many cases on our list, for example, have come but a few times, and have, therefore, not been able to benefit materially from a treatment which above all things demands patience and perseverance. The class system has, however, been found useful and might be carried to a further point than has yet been attained. To this matter we shall also revert later.

The cases in private practice, on the whole, have been more satisfactory, for the reason that they have continued treatment over long periods of time and with a devotion to detail which it is hard to secure in any but the exceptional hospital case, of which the patients alluded to above are examples.

Case IV. C., thirty-eight years old, a machinist by occupation. First seen in a markedly ataxic stage, the ataxia interfering greatly with his work and comfort. Absent knee jerks; Argyll-Robertson pupils; considerable disturbance in muscle-sensibility, but no marked hypotonia. Pains, gastric crises, and failing eyesight.

Exercises were at once begun and faithfully continued for many months. He regained a high degree of co-ordination and now, nearly three years after the beginning of the treatment, is relatively comfortable and able to work.

Case V. W., forty years old, was first seen June 6, 1904, suffering from extreme ataxia which had somewhat rapidly developed during the preceding eight months. There was some pain, slight sphincter disturbance, numbness of the legs. Even with the feet apart he stood only with great difficulty; muscular sensibility of the feet much impaired and objective blunting of skin sensation about up to the knees. Knee jerks absent; Argyll-Robertson pupils.

Exercises were begun and continued under instruction for upwards of a year, and since then alone. The improvement from the beginning was definite, and within a few weeks he has come to Boston, transacted various business which required walking in crowded streets and returned the same day to his home in a neighboring city. His confidence has been restored, and although his ataxia is still apparent to a trained observer, he is able to walk without undue embarrassment or fatigue, which was wholly impossible two years ago.

Case VI. J., thirty-four years old, seen Jan. 28, 1905, gave the usual history of lancinating pain, sphincter disturbance and loss of sexual power. Absent knee jerks, Argyll-Robertson pupils and a zone of diminished sensation under the nipples determined the diagnosis in spite of the absence of ataxia, except of the smallest possible degree.

Exercises were nevertheless undertaken and faithfully carried out, with the result that the patient acquired a much higher degree of co-ordination than the ordinary normal person has, which undoubtedly will be of much service to him when the inevitable ataxia begins to develop. This, so far as we know, has not yet occurred.

Case VII. D., thirty-four years old, was first seen May 8, 1905. He was a heavy man and excessively ataxic. Supported by a cane he stood only with the greatest difficulty and was practically incapable of walking without such a support. Lancinating pains, lost knee jerks and inactive pupils, with bladder symptoms and cutaneous sensory disorders of the legs, were all present.

Co-ordinative exercises had been previously undertaken in a half-hearted way with no visible result. In spite of this, the patient willingly undertook them again in systematic fashion, and has continued them for the year and a half which has intervened. He is now able to go up and down stairs with comparative ease, before almost impossible, and walks with a very considerable degree of assurance, slightly assisted by a cane. He is, however, still unable to go a distance, for example, a quarter of a mile, without much fatigue. This is partly due to his weight, and, no doubt, also to the high degree of the ataxia which he is continually forced to overcome. The improvement, however, has been gratifying, especially in view of the fact that the exercises were given up for a time owing to an intercurrent attack of pleurisy.

Case VIII. S., thirty-nine years old, seen Oct. 25, 1906. The patient had not walked for upwards of a month ; the arms were also extremely ataxic, and he was well started in the so-called paralytic stage. There was very considerable hypotonicity and disorder of joint and cutaneous sensibility, both in the arms and legs. The knee jerks were lost, the pupils unresponsive to light and the general clinical picture one of a late stage of the disease. In this case, as, in fact, in all the others, no systematic exercises had ever been prescribed.

Exercises were at once begun and now, at the end of a month, a number of exercises in the lying position are done with good muscular control and co-ordination. Standing and walking exercises are not possible as yet, and are still further complicated by the fact that the sensory loss in the hands — muscle sense and stereognosis — render it practically impossible for him to hold a cane or other support. This, with the general hypotonicity of the muscles and the very high degree of ataxia, renders the case an extremely difficult one. It is unfortunate that the exercises were not begun a year or more ago. As it is, we expect improvement, and probably some degree of locomotion. This case is the latest, as regards the degree of ataxia, which we have attempted to treat.

The foregoing cases are examples of the untreated tabes which one meets in private practice. With one exception they were all markedly ataxic when first seen, and all have been benefited except the last, which has been under treatment only a month. All, excluding the pre-ataxic case, might have been benefited much more had the treatment been begun months or even years before.

GENERAL INDICATIONS.

Co-ordinative exercises are far more useful in tabes than in any other lesion of the spinal cord or nervous disorder. Dr. J. Madison Taylor[1] has, however, placed on record an exceedingly successful treatment by this general method of a case of paralysis agitans. This case should stimulate others to give the method a fair trial in this practically untreatable disease. Our personal experience in the treatment of paralysis agitans by this method is small, but we have observed certain favorable results, not sufficient, however, to justify the exercises as a routine measure. The complication of inco-ordination with spastic conditions, diffuse combined degeneration giving rise to an ataxic paraplegia, is not in general amenable to successful treatment by this method. The spasticity renders the movements difficult to perform, and the general weakness which goes with a degeneration of the pyramidal tracts renders the effort greater than the patient can perform with success. In primary spastic conditions there is naturally no indication for the treatment, since the element of ataxia is lacking. In general, hypotonic conditions of the muscular system, with accompanying inco-ordination, are the conditions which provide the essential field for this form of treatment.

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[1] Taylor: The amelioration of paralysis agitans and other forms of tremor by systematic exercises. Jour. Nerv. and Ment. Dis., 1901, xxviii, 133.

Limiting, therefore, our consideration to tabes, it is at once evident that the different patients respond in widely different ways to treatment. A weak heart or highly sclerotic arteries are contra-indications except to the simplest form of exercises. A case under our care in which tabes was combined with exophthalmic goitre proved wholly impossible to treat on account of the circulatory conditions. Excessive adiposity is also a misfortune. Persons of small and slender physique are much less exhausted by the treatment and, therefore, regain co-ordinative power more quickly and permanently. Naturally, treatment of this mechanical sort is most successful in persons in good physical condition who have no handicap in the way of circulatory or other disorders. A very high degree of hypotonicity, especially if associated with Charcot joints, is naturally a complication.

In tabes the treatment may be instituted with hope of improvement at any stage of the disease, excepting the very latest. It is on the whole unusual for patients to present themselves in the pre-ataxic stage, and if seen at this early period of the disease it is at times difficult to impress upon them the importance of co-ordinative exercises when they have not been conscious of disturbances in locomotion. Two such cases are included in the series which make up the basis of this report, and one other was seen in consultation who has not undertaken the treatment. Of the two who accepted treatment, one (Case VI), with the characteristic signs of tabes apart from inco-ordination, was sufficiently impressed with his future prospects to undertake with great faithfulness the prescribed co-ordinative exercises. The result was that after several months of treatment, faithfully carried out, he was able to show a higher degree of co-ordination than an ordinary normal individual. Such a patient, if he perseveres in carrying out the exercises, is sure to avert for a greater or less length of time the otherwise inevitable ataxia. The second case, although also without ataxia at present, has been so far impressed with the rationality of the treatment that, after a series of exercises under instruction, he has agreed to prosecute them further, although obliged to be entirely away from medical supervision for a number of months. It is unquestionably very desirable that the treatment be begun in the pre-ataxic stage or as soon thereafter as possible, and in these cases naturally the best results may be expected if the importance of the procedure can be sufficiently impressed. This is in many cases not difficult, due largely to the common knowledge possessed by the laity of the discomfort and conspicuousness of the ataxic stage.

Patients, however, usually present themselves, at a later stage, and often, in fact, when they are on the verge of complete incapacity. The problem here offered is naturally a very much more serious one, and the treatment must be correspondingly thorough and long continued. With these patients there is no difficulty whatever in impressing upon them the importance of the treatment. They have in most instances been treated by various drugs and other inefficient means, with the result that their discouragement is almost complete and their willingness to undertake a treatment promising amelioration increasingly great. The incapacity at this stage is also so extreme that the ordinary employments of life are interfered with and the patients therefore not only have the inclination, but also the time, to give to the required work. Most of our patients have been seen for the first time and treated in this stage, and with uniformly good results when the treatment has been followed conscientiously for a reasonable length of time. It is to be hoped that as this method of treatment becomes more widely known patients will be treated much earlier than is at present usually the case. It is altogether unfortunate if they are left to reach the helpless stage before the exercises are instituted. Even in these late cases, however, good results may be expected and not infrequently it is possible to so far educate the co-ordination that persons previously confined to a chair may be able to walk to a certain degree. The exercises should, therefore, not be considered valueless even in the so-called paralytic stage of the disease.

ELEMENTS OF SUCCESS.

That the use of the Frenkel treatment has not always been attended with success is due in part to the unsuitability of the patients, which certainly in the case of tabes is rare, and more particularly to the careless and inadequate prosecution of the treatment, and to too great a confidence on the part of the physician that the patient is himself capable of directing his own treatment. To succeed, certain definite principles must be adhered to, as Frenkel has definitely pointed out in his comprehensive work on the subject.

First. — The instruction must be given in most painstaking fashion. This necessitates a teacher skilled in the method of treatment and preferably a person thoroughly acquainted with massage and physical training in general. This work, under ordinary circumstances, cannot be done by the physician for the reason that he has not the time and often not the knowledge which it definitely demands. Attention to detail is absolutely essential if results are to be expected. The patient must, from the outset, be impressed with the rationality of the treatment and with the absolute necessity of performing the various movements with the utmost possible precision. Slovenly methods are worse than useless and such methods can only be prevented by the constant, keen supervision of a teacher interested in the work.

Second. — Good results depend upon moderation. The tendency on the part of the patient, when once interested in the treatment, and particularly when he sees improvement, is to do too much. This is always detrimental, and it is a common experience to be obliged to warn the over-enthusiastic patient against this danger. The muscular effort connected with even simple movements properly performed is extremely great. It is, therefore, necessary that the pulse should be carefully watched and that the patient should rest frequently between the exercises.

Third. — The exercises, beginning gradually and with the more simple ones, must be carried out under the eye of the instructor for at least six months, and preferably for a year or longer. It is our custom to give the patient actual instruction three times a week, one hour at a time, with frequent intermissions for rest. In addition to these exercises the patient is instructed, morning and night, to go through certain prescribed movements by himself, care being taken not to prescribe more than he can properly perform without fatigue. In our experience there is no difficulty whatever in having these instructions carried out. When a certain number of the exercises are well mastered, both in the lying and standing positions, the visits of the instructor may become less frequent and finally the patient may with safety be thrown upon his own resources. He is by this time expert both in the principles and practice of the treatment, and may even be capable of elaborating the exercises still further without definite instruction. The exercises naturally must be continued indefinitely, inasmuch as the underlying pathological process continues to advance. The period of disability may by these means be somewhat indefinitely postponed.

Fourth. — The complete co-operation of the patient must be secured if the treatment is to prove a success. After the first few exercises, which require considerable tact on the part of the instructor, some signs of improvement are usually apparent, and, thereafter, there is small difficulty in keeping alive the patient's enthusiasm.

Fifth. — The class system is useful and available in hospital practice. Three or four patients, either at approximately the same or at different stages of the disease, may, with much advantage, be given the exercises together. One patient may rest while another is going through certain of the exercises, and the fact of companionship proves a stimulus to the conscientious performance of the work.

For about two years such a class has been maintained at the Massachusetts General Hospital with success. Several of the patients have been coming regularly for from one to two years and evidently take much pleasure in performing the exercises prescribed. New members may be added to the class from time to time, and those who have been longer under training may serve, in a measure at least, as teachers of the newer arrivals. In private practice naturally such a method is rarely, if ever, available. Its danger lies in giving the patients too much latitude and in trusting too far to their individual capacity to perform the exercises correctly. Naturally, this danger is lessened the longer the exercises are continued. The element, how-

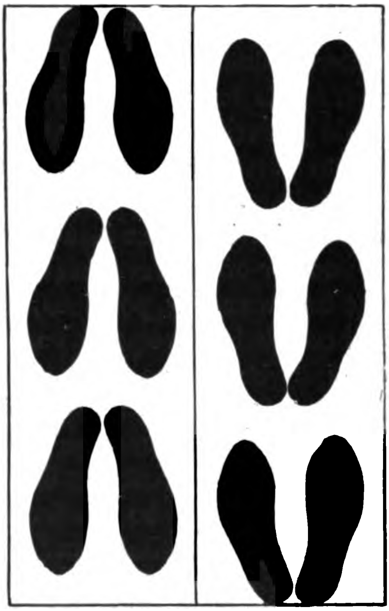

FIG. 1. Modified from Frenkel. Linoleum or canvas on which is painted footsteps, preferably in one series, instead of in two as here represented. The strip should be from 18 to 24 inches in width, and for persons of average height the distance between the steps 4 inches. For a very short person it should be less, and for an unusually tall person, more. The separation between the heels and the toes should vary somewhat, depending upon the personal idiosyncrasy of the patient. The patient is required as far as possible to adjust his steps to the footprints.

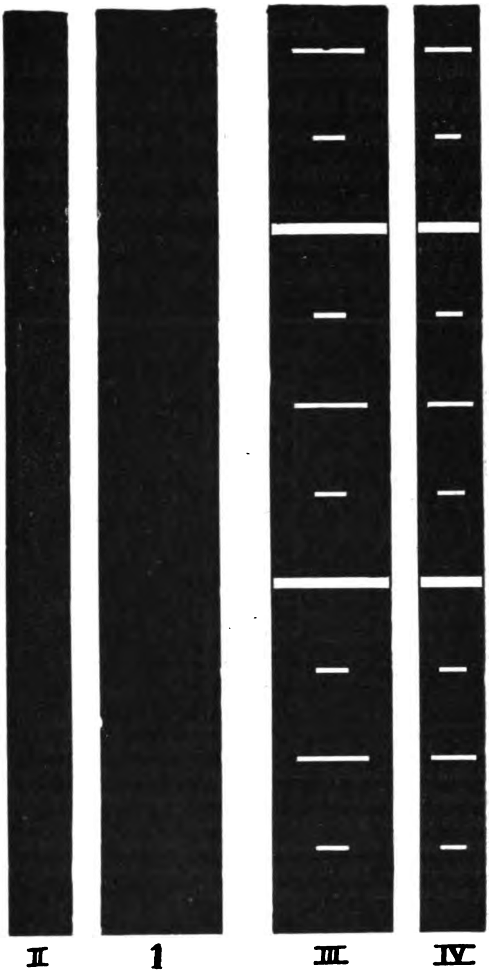

FIG. 2. Modified from Frenkel. I. Strip of linoleum or canvas, or painted directly on the floor, 9 inches wide and 10 to 15 feet long. II. The same, 4 inches wide. III and IV similar to I and II respectively, but with cross-markings at intervals of 27 inches, a full step, and at 13½ and 6¾ inches, a half and a quarter step. The use of these strips is obvious, the demand for more perfect co-ordination increasing from the broad plain strip I to the narrow marked strip IV.

ever, of strict personal attention to the individual case must never be neglected if the best results are to be attained.

APPARATUS.

The appliances necessary for the treatment are easily made and do not need to be renewed. The essentials are, first, a couch. This may be of wicker with one end elevated and with a hard base of support for the body. (See Fig. 6.) Such couches are relatively inexpensive and may be easily obtained from any well-equipped furniture store. The disadvantage of such a couch is that its surface is very slippery, and the tendency, therefore, is for the patient to slip down while taking the exercises on his back or else to use considerable muscular energy to maintain his original position. This may be obviated by placing a piece of felt or some other rough material under the buttocks. If such a couch is used, this should always be done, since the patient requires all his strength and attention to perform the specific movement desired.

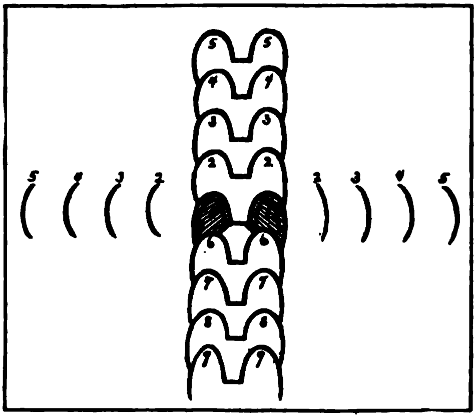

FIG. 3. Modified from Frenkel. Linoleum painted as represented, and the possible positions of the feet indicated by numbers. The patient standing at 1, 1, is directed by the instructor to place the feet in various positions as indicated by the figures. This is done at word of command, and is a very useful exercise of the later treatment. The distance between the vertical steps is 6 inches, and between the lateral, 5½ inches.

A better couch for the purpose is one put together of stout timber with the seat open. This should then be covered by a tightly stretched canvas which affords a non-slipping surface more satisfactory than that of the ordinary wicker couch of which we have spoken above. Such a couch as this may very easily be made by a carpenter of ordinary pine stock and serves the purpose on the whole better than any other apparatus. Particularly to be avoided is the ordinary couch, sofa or bed which is far too yielding for the proper performances of the exercises. Such a couch as that described above is all that is required for the beginning exercises taken on the back. A little ingenuity,

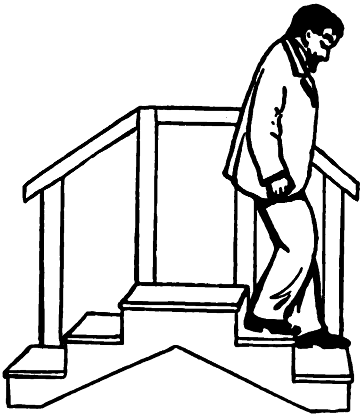

Fig. 4. Modified from Frenkel. Steps with railing for support. The treads are 6 inches in width and 9 to 11 inches long.

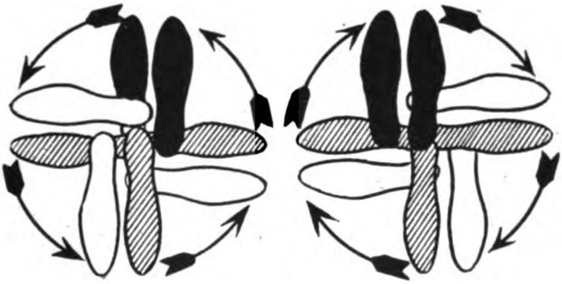

Fig. 5. Modified from Frenkel. Arrangement of steps for turning movements.

with perhaps a small expenditure of money, will easily provide this.

For the walking and turning exercises the apparatus required is equally simple. A strip of linoleum or canvas, approximately twenty feet in length and marked off in footsteps as indicated in Fig. 1, is requisite. In addition to this, strips of two widths with and without cross-markings at regular intervals, as shown in Fig. 2, are very desirable, if not absolutely necessary. A so-called Geneva cross, illustrated in Fig. 3, is an extremely useful piece of apparatus for the later exercises. A series of three steps, as shown in Fig. 4, or, as a simpler device, a solid box upon which the patient may step with safety is a useful adjunct to the treatment and gives opportunity for the somewhat difficult co-ordinative movements used in going up or down stairs. Many other devices of more or less complicated sort may naturally be used to assist in the training of the co-ordination. If, for example, the arms are ataxic, a board is useful into which many holes are bored, the patient being required to insert a peg into one or another hole, either by command or through an act of his own will. These details, into which it is not our purpose at this time

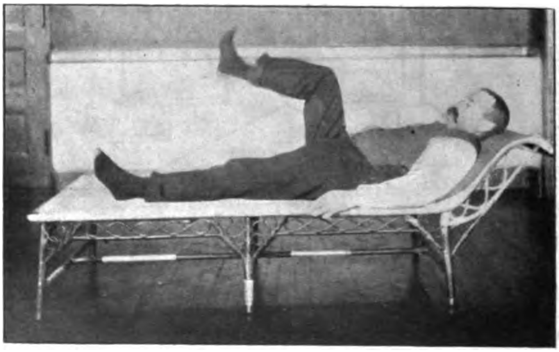

FIG. 6. Exposure, 10 seconds. Wicker couch used at Massachusetts General Hospital, showing performance of a free leg exercise in the recumbent position. The co-ordination is practically perfect, in spite of the awkwardness of the position.

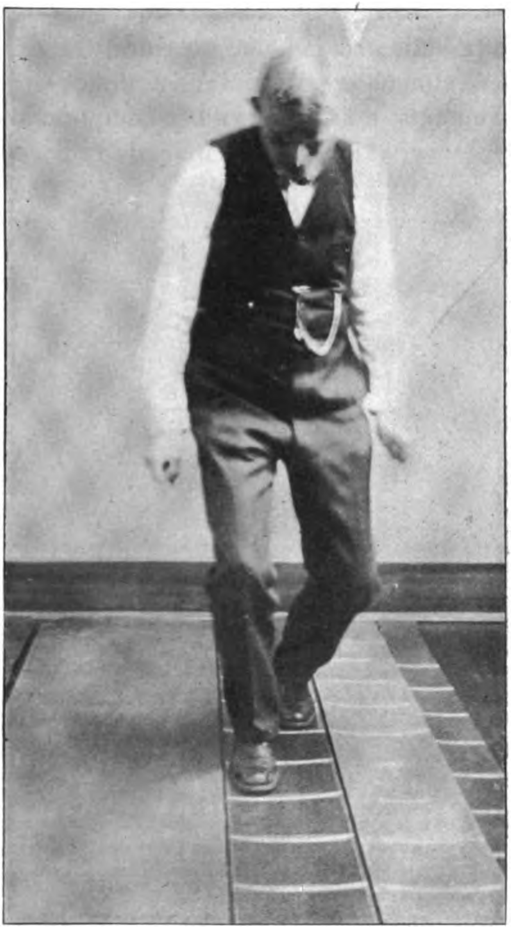

FIG. 7. Exposure, 10 seconds. Walking exercise on narrow strip, in steps of given length. The care and attention of the patient is well shown. The co-ordination is excellent. Massachusetts General Hospital.

In the walking exercises the knees should be well bent, and also the thigh on the body. The knees should be kept on a line with the toes.

to enter, are discussed at length in Frenkel's admirable book.

METHOD OF TREATMENT.

As already indicated in some measure, the essentials to successful treatment are a training of the co-ordination in simple movements, going on to more complex, at first with all the assistance which can be gained by position of the body, use of the eyes and even artificial aids. It is not necessary to detail these movements, inasmuch as those originally suggested by Frenkel and pictured in his book have, so far as we are aware, not been improved upon. We call attention rather to the photographs (Figs. 6, 7, 8, 9, 10) of patients actually undergoing treatment, which illustrate better than words could do the means taken to improve the co-ordination and the success which attends

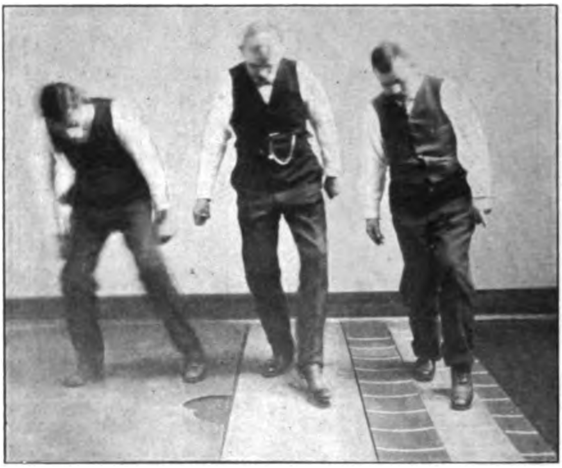

FIG. 8. Exposure, 10 seconds. Class work, Massachusetts General Hospital. Patient to the right is walking on a strip with cross marking, as in Fig. 7. Fair co-ordination. The center patient is walking on footprints, not clearly shown in photograph, one of the simplest of the walking exercises. Excellent co-ordination. The patient to the left is making a side step, a much more difficult movement. There is considerable inco-ordination, as clearly shown in the photograph.

the effort. The photographs were taken indoors and received an exposure of approximately ten seconds. It may, therefore, be seen how complete a co-ordination was obtained in those cases where no blurring of the image takes place. This is true in many instances. In others, however, it will be seen that a certain ataxia developed before the expiration of ten seconds, which it is not difficult to understand when one observes the difficult positions which the patients are attempting to maintain.

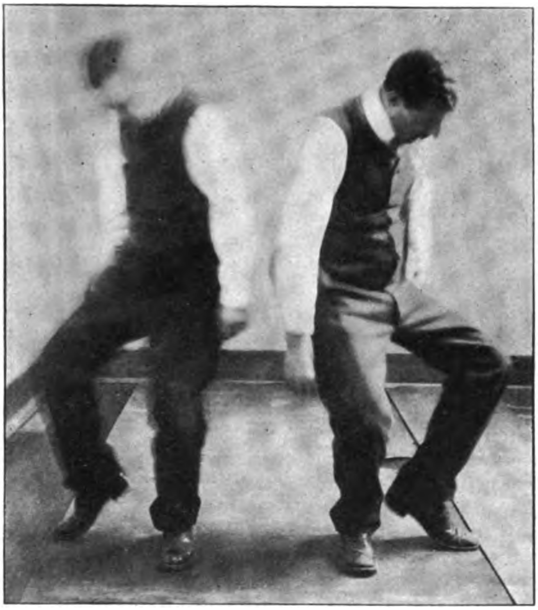

FIG. 9. Exposure, 10 seconds. Turning movements. Patient on the right has maintained good co-ordination. The patient on the left shows no great ataxia of the legs, but the upper part of his body is unsteady. Massachusetts General Hospital.

The result of our application of the Frenkel method in the treatment of tabetic ataxia has led to the following conclusions: That the method is equally applicable to hospital and private patients; that the class system is useful but must be guardedly used; that the moral effect upon the patients is admirable, leading to determined efforts towards perfecting themselves in the exercises prescribed; that the other symptoms of the disease — sphincter disorders, general sensory defects and pain — are indirectly beneficted; that if the treatment be carried out faithfully under direction for six months or more definite improvement is sure to result unless complications set in or unless the patient presents himself for treatment at too late a stage; and finally, that this method of treatment, conscientiously carried out, should not be neglected or postponed in any case of uncomplicated tabes.

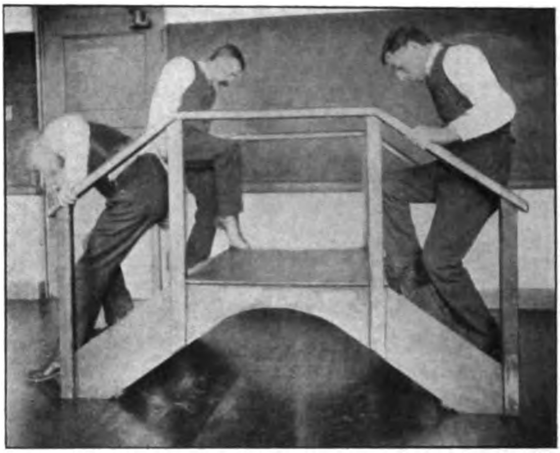

FIG. 10. Exposure, 10 seconds. Class work, Massachusetts General Hospital. Practice on the steps. The co-ordination is in general good. The care which the patients are taking is characteristic of all who are well taught.

The patients represented in this series of photographs were all highly ataxic when they first came under treatment, and all have been taking the exercises for upwards of a year. They are the nucleus of the hospital class.

THE ANALYTIC METHOD IN PSYCHOTHERAPEUTICS. ILLUSTRATIVE CASES.*

By Harry Linenthal, M.D., and E. W. Taylor, M.D., *of Boston.*

From the Department of Neurology, Massachusetts General Hospital.

The attempt has been made during the past year in the Neurological Department of the Massachusetts General Hospital (service of Dr. J. J. Putnam) to systematize methods of mental treatment. The investigations of the past few years have conclusively shown that much may be expected from a judicious and painstaking application of methods of mental treatment, quite apart from the use of hypnotism. The recent book of Dubois on this subject, various papers by Freud, and the comprehensive work of Janet[1] and others[2] will no doubt have a wide influence in rationalizing a method of treatment which has too long been regarded as without the pale of therapeutic effort.

A fundamental difficulty in psychotherapeutics up to this time has been a lack of method. With this in mind an attempt has been made at the Massachusetts General Hospital to select certain patients presenting themselves at the Out-Patient Department, and to treat them in a systematic and rational manner, without the use of drugs. The results up to this time have been so far encouraging that it is expected a more complete trial will be given the methods this coming winter, whereby it is hoped sufficient data may be obtained for a somewhat comprehensive report.

It will not be questioned by those familiar with an ordinary neurological out-patient service that a very considerable number of patients appear whose ailments require, not the use of drugs or of mechanical means of treatment, but rather analysis of the disordered mental state, and treatment of the condition based on the results of such an analysis. It is to this class of patients that our efforts have up to this time been directed, and with results which unquestionably justify the further prosecution of work along the same general line.

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* Published in the Boston Medical and Surgical Journal, Nov. 8, 1906.

[1] Professor Janet is at the present time delivering a course of lectures on Psychotherapeutics, in the Lowell Institute Course in Boston, a further indication of the general interest which the subject is exciting.

[2] Under the care of Dr. J. J. Putnam and Dr. G. A. Waterman, admirable results have been obtained through psychotherapeutic methods, in patients admitted to the hospital (neurological ward). See Boston Med. and Surg. Jour., 1904, cli, 179, and Putnam, Jour. of Abnormal Psychology, 1906, I, 26. See also Barker, Am. Jour. Am. Sc., 1906, cxxxii, 499.

We have no desire at this time to enter into detail regarding the methods employed. The essential feature is, first, an analysis of the mental states underlying the condition as it appears on the surface, and an attempt by explanation and reason to allay the fears to which the patient's false interpretation of the condition has given rise.

As examples of a type of disorder which may be reached by the methods employed, we quote the following cases. A large number have been treated more or less completely by similar means, but these illustrate better than others the principles involved, and the excellent outcome of the treatment is certainly ample justification for their publication.

Case I. Miss C., age thirty-four, single, suffers from recurrent loss of speech of which she gives the following history:

For many years, especially during the winter months, she has been subject to colds with a tendency to hoarseness. About one year ago she had one of these attacks of hoarseness with some cough, apparently a laryngitis, when she suddenly lost her voice completely and this condition lasted for several days. Since that time she has been having recurring attacks of loss of voice, coming on apparently without definite cause. These attacks have become more and more frequent and of greater duration. She has been coming to the clinics of the Massachusetts General Hospital for the past six months. The note from the Laryngological Department on the first examination reads: "Laryngoscopic examination shows normal movement of the cords. Patient phonates with mirror in position, but stops when the mirror is withdrawn." The diagnosis of "hysterical aphonia" was made.

The application of the faradic current to the throat and other means would in a very short time restore the voice. She would leave the hospital apparently cured, only to come back in a few days as bad as ever, not being able even to whisper. She was thus coming regularly for electrical treatment, getting only temporary relief; her condition grew worse and she became unable to use her voice the greater part of the time. Beyond general nervousness and irritability she complained of no other symptoms.

Physical examination was entirely negative. All superficial and deep reflexes were normal. There was no anesthesia and no limitation of the visual field.

It was thought desirable to probe to the bottom of this case, to find out, if possible, what was the meaning of the aphonia coming on in an otherwise healthy, though nervous, young woman. With this end in view we questioned her closely as to her previous life, as to emotional traumas and as to her family relations. The patient was very timid and reticent. She seemed to resent greatly this scrutiny into her life, and the fact that notes were taken while talking with her disturbed her very much. She answered in monosyllables and volunteered very little information, although it was quite evident that there was something in her mind about which she did not wish to speak. She was assured that it was not mere curiosity that prompted these questions, but that in order to effect a permanent cure we must have her confidence.

Two days later the patient came again to the hospital unable to speak. Her voice was restored by the faradic current, and much against her will she was retained and questioned again. Very uncommunicative at first, her confidence was finally obtained and she told us of her trouble. The great misfortune of her life, she told us, was that a brother of hers, to whom she had been greatly attached, had become insane and was in an insane asylum for several years, where he recently died. This unfortunate episode in her family she regarded as something that must never be spoken of. It was something which the family was ashamed of, and about which no one must know. She had undergone a struggle before she decided to speak to us about it.

Now that the ice was broken, however, she became more communicative. While her brother was in the asylum it was her painful duty to visit him once a month. Each visit was to her the most trying ordeal, and it took several days before she could get over the depression which the sight of her unfortunate brother produced. On several occasions her brother became maniacal while she was present; on one occasion particularly he attacked the attendant while she was there, and was handled very roughly in consequence. Further questions elicited the fact that frequently the visits to her brother were made while she was suffering from an attack of laryngitis and hoarseness. She had a particularly severe attack of hoarseness on the visit when her brother attacked the attendant.

Before leaving, the patient assured us that she had not felt so well for a long time; the narration of her troubles gave her a great deal of relief, "as if a burden were taken off her shoulders."

Freud has in a number of communications of recent years pointed out the important rôle which suppressed mental states play in the activities of our daily life, the extent to which they enter and determine the phantasmagoria of our dream states, and the prominent part they play in the evolution of hysteria. For various motives, either because of the painfulness of the states themselves, or owing to the fact that these states do not harmonize with our moral convictions or with our social environments, there is a prevalent tendency to suppress them. They do not, however, remain dormant but profoundly influence our activities and give rise to a variety of manifestations. In his "Psychopathology of Everyday Life," Freud points out that such commonly occurring phenomena as the forgetting of familiar names, slips of the tongue and of the pen, mal-adjustments, and accidental and purposeless acts, all are the manifestations of subconscious motives.

But this suppression of mental states plays a far greater rôle in the etiology of hysteria. The patient has an unpleasant emotional experience which for one reason or another he suppresses. The cerebral excitation set up by the emotion not finding its normal path of discharge, because the patient forces that emotion from his conscious attention and does not react upon it in the normal way, will discharge itself in an abnormal path, will become "converted" into a somatic phenomenon, and give rise to an hysterical symptom. This process Freud designates as "hysterical conversion."

The particular symptom into which the emotional excitation will become "converted" depends on a variety of conditions. Co-existence in time is a prominent factor in this conversion. If at the time of the original trauma a certain sensory or motor state existed that state will tend to recur whenever the emotion is aroused. But owing to the effort of suppression the emotion will ultimately remain subconscious while the associated state will recur as an hysterical symptom. The association between the suppressed emotion and the converted symptom need not necessarily be that of co-existence; it may be a very trivial chance association, or the somatic manifestation may be but a symbolic representation of the suppressed state as, for instance, nausea and vomiting as a result of moral degradation and disgust.

In our case the loss of voice is the "hysterical conversion" of the large number of emotional traumas which the patient sustained on her visits to the asylum. Social prejudice was the motive for the suppression of these emotions. While sustaining these traumas the patient frequently suffered from hoarseness, particularly at the time that her brother, in a maniacal state, attacked the attendant. Thus the emotions and inability to speak were associated and the latter became the converted somatic phenomenon of the suppressed emotional state.

It is still further possible that the aphonia has, in this case, a symbolic meaning. The sole aim of the patient was to prevent what she regarded as a family stain from gaining publicity. This must be kept secret at all costs. She must never refer to or speak of her unfortunate brother, hence the aphonia.

Once the case was analyzed the therapeutic measures were to relieve the patient's mind of the popular prejudice that exists about insanity. She was given to understand that insanity is a misfortune and not a crime, that there is no more shame connected with it than there is with physical disease. Moreover, the condition was fully analyzed to her and in simple language she was given to understand how her trouble originated.

The aphonia never returned[1] after the first explanation and although she came regularly to the clinic for several months she did not lose her voice once. On one or two occasions she came in with hoarseness but no loss of voice. The condition cleared up completely, and now after ten months the patient is well and considers herself cured. She assures us that she has never felt so free from nervousness and irritability as she does now.

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[1] Since these notes were written, a temporary relapse occurred due to an emotional strain, but the aphonia was easily overcome by the simple process of explanation and an appeal to reason.

The case derives its interest from the facts that the patient was temporarily relieved of her aphonia by various relatively simple means, but that it recurred with increasing frequency until a rational cause for its occurrence was discovered, and explained to the patient. From that time on the relief has been essentially permanent.

Case II. Mrs. B., a young Jewess, of twenty-eight, came to the neurological clinic of the Massachusetts General Hospital complaining of peculiar "nervous attacks," of severe headaches, and of a variety of nervous symptoms which "made existence almost unendurable." According to her story she was perfectly well till one year ago. The attacks which during the year have, in spite of treatment, increased in severity and frequency are as follows:

The attacks most often come in the morning about twenty minutes after rising. She begins to feel "queer" and finds herself "shaking all over." A few minutes later she hears noises of ringing bells in her right ear; her vision, especially of the right eye, is blurred and she sees stars and flashes of light in front of her. She feels very weak and restless. The house is too small to hold her. She leaves the house and walks up and down the street for about twenty minutes, when the attack usually passes off. On returning to the house she feels weak but is able to attend to her work. She never loses consciousness during the attack, and she knows and recognizes her surroundings, although she states that things look queer to her "as if they were far away." From two or three a week, these attacks have increased in frequency so that she now has them almost every day. In the intervals of attacks she suffers from severe occipital headaches which have not been relieved by glasses.

Physical examination of the patient was entirely negative. All the superficial and deep reflexes were present and normal. There were no motor or sensory disturbances. Her field of vision, by rough test, was normal. Hearing was good and equal on both sides. Sense of taste and smell normal.

On careful inquiry the following history was obtained. About a year ago the patient and her husband were awakened in the middle of the night owing to a fire which broke out in a neighboring house. Partly dressed, in a dazed condition, she was put out in the street and was much terrified by the flames and smoke which confronted her. In a state of collapse she was taken to a neighboring house, where she rested for a few hours and later was taken home. She had become somewhat composed, but she felt "that the severe fright was bound to leave some ill after-effects." One morning about three weeks after the accident, the patient, without any apparent cause, had one of the attacks described above, and in spite of medical treatment she has been having these attacks since with increasing frequency.

In addition to the attacks and headaches the patient complains that since the fright she is not the same as she used to be. Her character has undergone a radical change. While formerly rather calm and composed, she has become extremely irritable and easily annoyed by trifles. Things and persons formerly of great interest have ceased to attract her. She has become indifferent to her friends to whom she was formerly much attached. While formerly fond of reading she is unable to read now, since she cannot fix her attention for any length of time.

For about six months after the fire the patient's sleep was greatly disturbed by distressing dreams. Very frequently she lived through in her dreams the disturbing experiences of the memorable night. During the last few months, however, her dreams have been commonplace, concerned as they are with the affairs of her daily life. Very frequently she wakes in the morning knowing that she has had a distressing dream, but is unable to recall the content.

It is apparent from an analysis of the attacks that they are directly related to the emotional shock of the night of the fire. The attack, it may easily be seen, is an exact reproduction of the original trauma. During each attack she lives through the exact sensory-motor and emotional states of the original fright, without recognizing them. The feeling of queerness, the lack of the feeling of reality which she experiences at the beginning of each attack, reproduce the semi-waking hypnoidal state she was in on that night when she went out in the street. The noises in her ears, the ringing of bells, are a reproduction of the bells and noise of the fire engines. The blurred vision and the stars which she sees reproduce the smoke and the sparks which confronted her as she emerged from the house. So detailed is the reproduction that even the motor phenomenon of going out into the street is reproduced at each attack.

The emotional tone of the attack is a vague, general, objectless fear. We have here a phenomenon common in hysteria, the dissociation between the emotional tone and the ideational content. The latter remains subconscious while the former comes to the surface manifesting itself as vague fear. Often the fear attaches itself to some indifferent object and thus gives rise to various phobias. Such a dissociation between the emotional tone and content is a sufficiently common phenomenon of dream states. An intense emotion of waking life will repeat itself in a dream state, but with an entirely different content. The emotions of the dream have no relations to the representations, to the phantasmagoria of the dream. They do not belong together. The emotional tone of the waking experience is transferred to the otherwise indifferent dream representations.

In view of the recent work that has been done on hysteria, in this country, notably the work of Sidis and Prince, the analysis of such a case is perfectly clear. The patient lived through an emotional experience which produced a severe shock. At the time of the trauma she was in a semi-waking state. The hypnoidal state and the emotional trauma prevented a complete synthesis. The traumatic experience with its sensory-motor manifestations remained dissociated from the rest of the patient's mental life. This complex of experiences because of its dissociation remained removed from the inhibitory influences of the rest of the mental life.

Sidis has pointed out how these subconscious states because of the low type of their mental organization become automatic and tend to recur. Their dormant activity may be awakened by the stress of an emotion or by the association of ideas, and when thus awakened they react in a stereotyped manner. The entire group of sensorimotor experiences characterizing the original trauma is reproduced and the patient lives through subconsciously the original experience without realizing its meaning.

To have established beyond all doubt the existence of the subconscious states in this case it would have been necessary to put the patient in hypnosis, to artificially induce an attack and thus come directly into communication with the subconscious. Unfortunately, the conditions in an out-patient clinic are not favorable to such a procedure; moreover, for the therapeutic result such a procedure was entirely unnecessary. The cure of this case was most satisfactory, and to the patient it appeared nothing short of the miraculous. The whole condition was analyzed to the patient and the meaning of the attacks was explained to her in a very simple way. The result surpassed all expectations. The attacks have not recurred after the first talk we had with the patient. The patient was seen frequently for several months with a continuous and marked improvement in her general condition. The headaches have disappeared and she has become less irritable and more like her former self. A few weeks after the treatment was instituted the patient's husband met with a very serious accident and he was for a time in the hospital in a critical condition. But even under such distressing circumstances the attacks did not recur, and the patient herself saw in that the sure sign of her complete recovery.

There seems no sufficient reason why a method of this sort should not be more extensively used in out-patient medical work. The small intelligence of some patients renders the task a difficult one no doubt, but in the great majority of cases a little perseverance will accomplish the desired results. The patients themselves quickly learn to realize the value of the suggestions made to them in the course of the analysis of their conditions, and appreciate also the time given and the effort made by the physician in their behalf. A very large proportion of the patients are amenable in greater or less degree to this type of treatment, and although many still clamor for drugs it is not to be doubted that a relatively small amount of effort directed toward their education in these matters will easily remove this preconceived idea, to the benefit of all concerned.

The immediate need of the future is to rationalize and at the same time systematize such methods of treatment. It is equally essential that certain men should perfect themselves in dealing with abnormal mental states by means of mental methods.

We hope to supplement this merely preliminary statement by a more detailed record of results when our experience has broadened sufficiently to make such a report of value.

THE EVOLUTION OF A CASE OF MYCOSIS FUNGOIDES UNDER THE INFLUENCE OF ROENTGEN RAYS.*

By Charles J. White, M.D.
Instructor in Dermatology in Harvard University.
And Frederick S. Burns, M.D.
Assistant in Dermatology in Harvard University.

The presentation of this paper is made with much chagrin, for it records the death of a man who succumbed to the effects of a too rapid relief from his malignant disease.

The patient was fifty-two years of age, a farmer by occupation, a native of this country, and a man who had always enjoyed the best of health.

The present disease began in March, 1902, with a slight eruption between the shoulders, and from that time on the disease had gradually extended. The earliest lesions were small, slightly tender, red infiltrations, usually surmounted by thick brown-white scales. Pruritus had always been a prominent symptom. As time went on other lesions appeared on the extremities and especially on the back, while the original plaques became prominent and nodular.

In June, 1904, a red area about an inch in diameter, developed on the pubes and was capped by a crust which soon gave place to an ulcer which, in a short time, reached the size of a hen's egg. Four other patches of a similar nature appeared on the pubes and underwent the same evolution, thus producing a localized, irregular, ulcerated surface. These important lesions were not accompanied by much pain and apparently did not interfere with the man's general health.

On June 26, 1904, the man entered the Skin Ward of the Massachusetts General Hospital. Physical examination revealed a well developed and nourished man. Pupils reacted equally to light and to accommodation. The throat showed a mild follicular pharyngitis with small, palpable glands in the neck. The lungs were normal.

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*Read before the Twenty-ninth Annual Meeting of the American Dermatological Association, New York, Dec. 28, 29, 30, 1905. Reprinted from the Journal of Cutaneous Diseases, May, 1906.

The pulse 72 beats to the minute, regular and of good size and tension. Over the apex of the heart there was a well marked systolic murmur, poorly transmitted to the axilla. Liver and spleen were normal in size; abdomen normal to palpation and percussion; the bowels constipated. The urine was slightly high in color, 1020 in specific gravity, acid in reaction and contained 2.5 per cent. of urea. Albumen and sugar were absent. The sediment contained nothing abnormal.

The forehead, eyebrows and eyelids were thickened and leathery and covered with scales in ill-defined patches. Similar, but less marked patches were scattered over the scalp, cheeks and neck. On the trunk were numerous lesions varying in diameter from one-half to five inches, roughly arranged along the lines of cleavage, discrete and confluent and presenting all gradations in consistency from round, deeply colored, slightly infiltrated scaling macules to small and large, round, oval and oblong tumors, elevated one-half inch above the surface, and firm, hard and painless to the touch. The extremities showed small, sparse tumors, more numerous on the thighs. The area below a line drawn between the crests of the ilia presented a solid mass of swollen, red, thickened tissue, most prominent on the left side, where there were three ulcers. The uppermost and largest of these ulcerations was irregularly oval, one inch by two in diameter, with concave, red, glistening base accompanied by abundant serous exudation. The upper edges of this ulcer were precipitous, the lower sloping. The other ulcers were similar in character, but smaller. Extending from the left ilium to the scrotum, appeared a long fold of hypertrophied skin about an inch in thickness, topped by a deep longitudinal fissure. The inguinal glands were distinctly infiltrated. The scrotum was considerably swollen, due partly to induration of the skin, partly to œdema of the tissues beneath.

June 29. X-ray exposures were begun.

June 30. Starch baths; ulcers cleaned with hydrogen peroxide and enzymol.

PLATE XVIII.

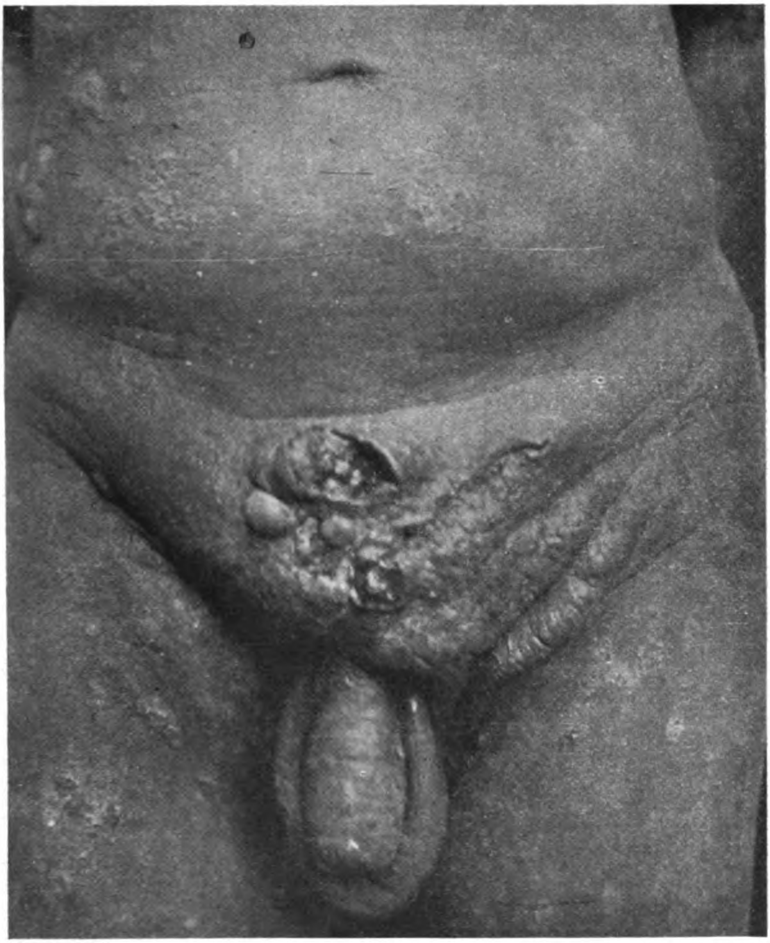


PLATE XIX.

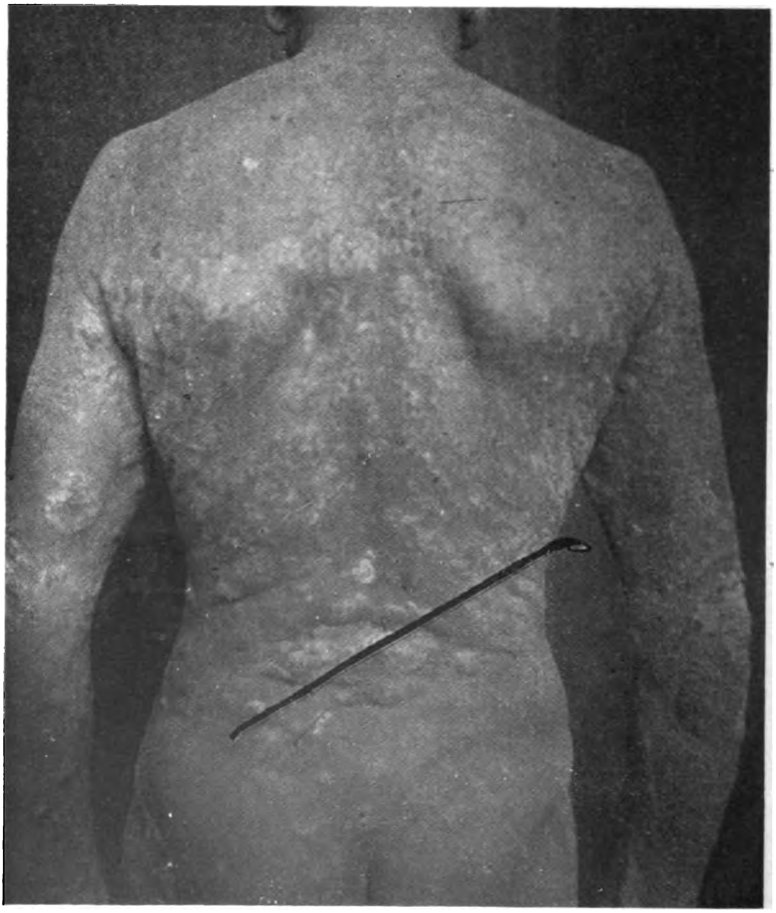


PLATE XX.

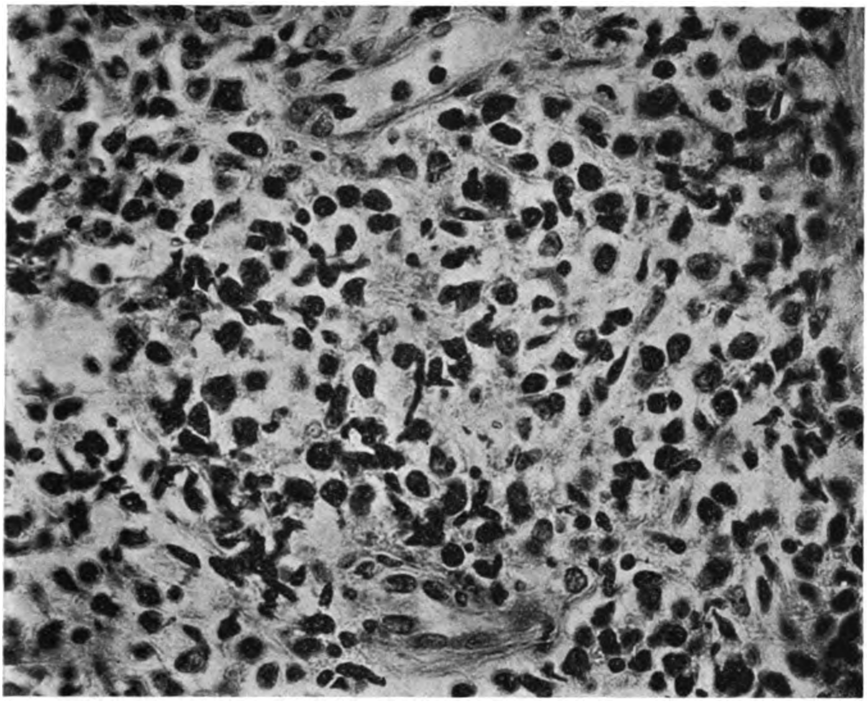


FIG. 2.

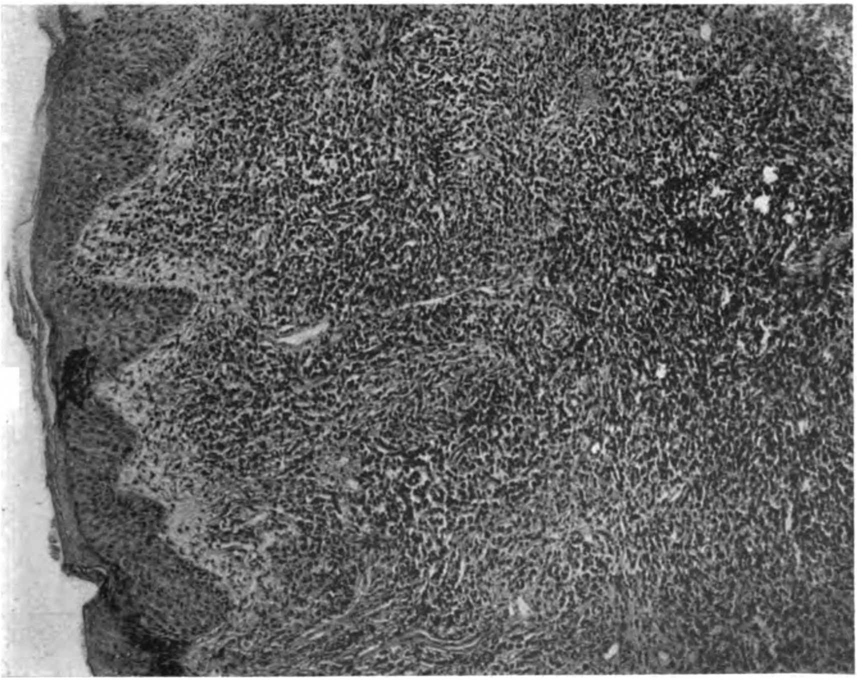


FIG. 1.

PLATE XXI.

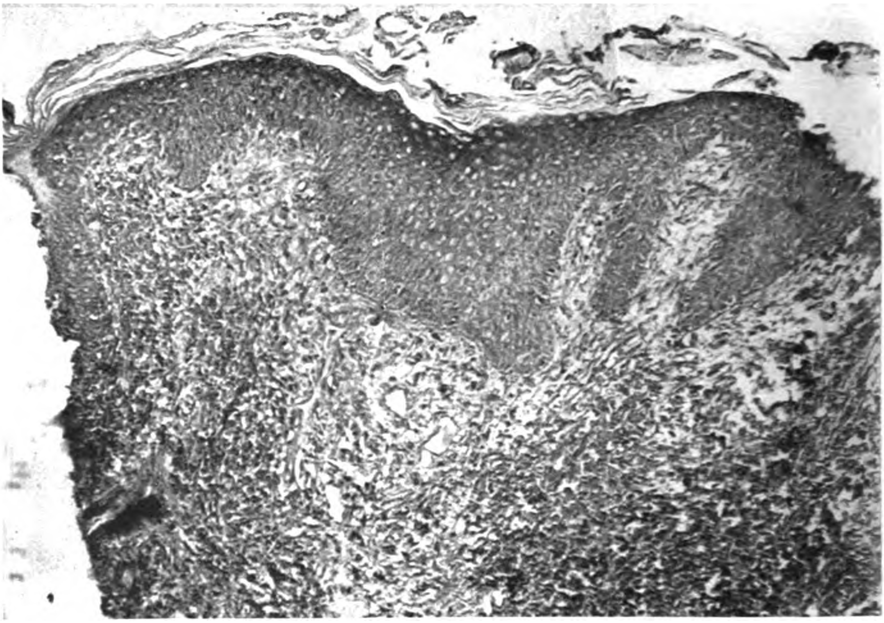


FIG. 3.

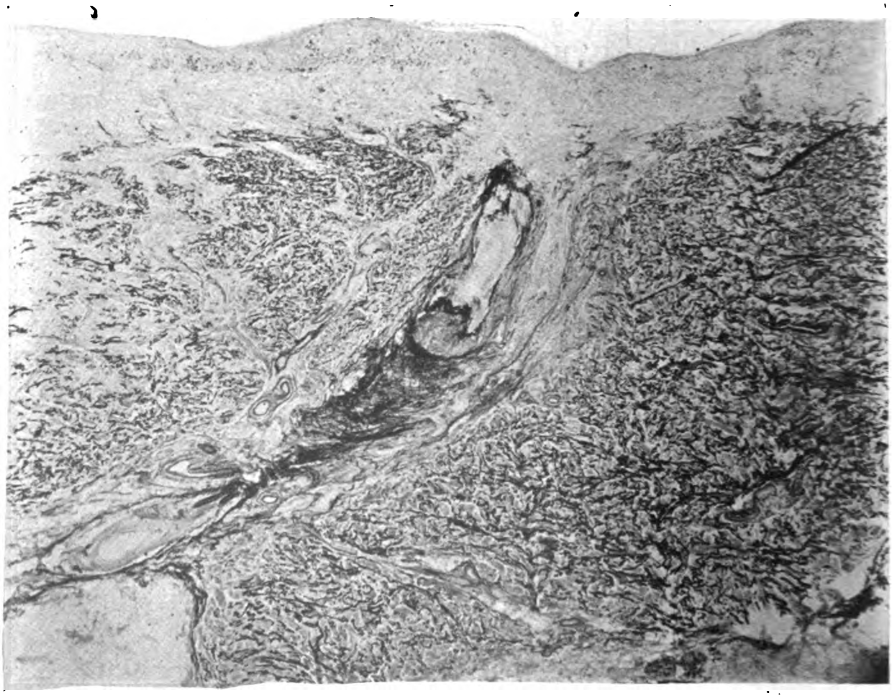


FIG. 4.

PLATE XXII.

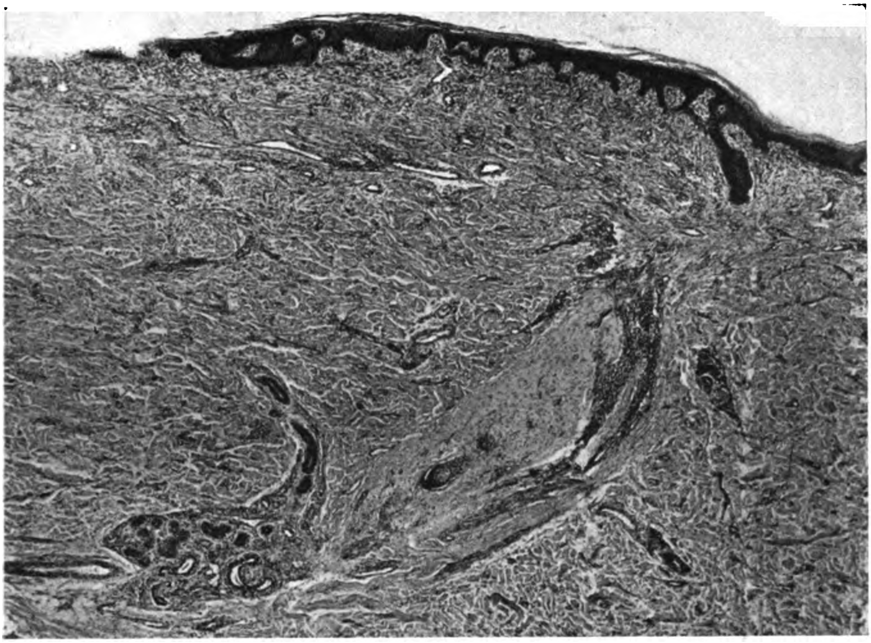


FIG. 5.

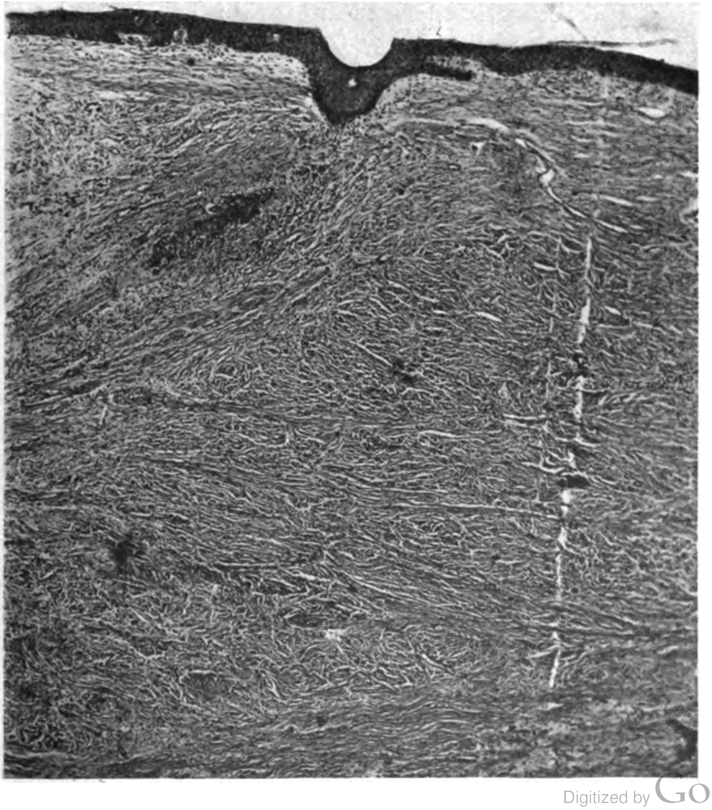


FIG. 6.

July 6. Hair of scalp and eyebrows decidedly thinned. Over the scalp and face sparsely disseminated, round and slightly elevated nodules were noted varying in diameter from ¼ to ½ inch. The general appearance of the skin was dull and dusky red in color. Between the body tumors the integument decidedly infiltrated and smooth and shining in appearance. The pubic ulcerations were cleaner and healthy granulations were already evident. The rugæ of the scrotum were highly accentuated.

General exposure to x-rays. Ointment of salicylic acid and bismuth to the face. Ointment of boracic acid to body surface elsewhere. Wash of tartrate of iron and potash and applications of hydrate of potash to the pubic ulcers. Liquor potass. arsenit. three minims t.i.d.

July 12. The scrotum more swollen and œdematous. Omit Fowler's solution.

July 19. The hypertrophic and ulcerated supra-pubic tissues were much reduced in thickness and the ulcerations were almost free from sero-purulent accumulations.

July 20. Bisulphate of quinine grains V and florescin (1-30 sol.), minims X t.i.d. To the scrotum a wash of tincture of opium and subacetate of lead.

July 23. Œdema of scrotum much diminished.

August 3. Fluorescin was omitted on account of polyuria.

August 10. Supra-pubic region much improved and presented an irregularly round, nodular plaque studded with clean granulations. The lesions on the back were shrunken, but some had slightly ulcerated on the surface. Both feet moderately œdematous and pitted slightly on pressure.

August 15. Infiltration of face considerably abated. Back of hands much thickened. The tumefactions of the body generally decreased in size and elevation, while the skin as a whole exhibited a light bronze hue.

August 18. Urine high in color; specific gravity 1022; acid in reaction and albumen in slightest trace. ℞ Acetate of potash three drams, t.i.d. Blood:—Red cells practically normal in shape and amount. White cells 16,000. Neutrophiles 60 per cent., small lymphocytes 29 per cent., large lymphocytes 8 per cent., eosinophiles 2.5 per cent., basophiles 0.5 per cent.

August 22. A marked change. Temperature 103.5, respiration 25, pulse 100, strong and regular. Lungs negative. Slight systolic murmur at apex. Heart not enlarged. Visceral examination negative. No discomfort and no pain. ℞ Alcohol bath. Spirit. æther. nitros. Salts. X-ray exposures stopped.

August 23. Temperature 104. Pulse 100, regular and of good tension. Respiration 21. Slight headache. Alcohol baths have not reduced the temperature. ℞ Ice-water sponge bath.

August 24. Moderate headache. Pulse intermittent. ℞ Phenacetin gr. V every half hour for three doses. The infiltration of the skin everywhere has markedly subsided since the advent of the febrile condition. Most of the tumors flattened to the general body surface. The bronze tint of the skin more pronounced. ℞ Continue ice baths. Salt solution per rectum, six ounces every four hours. Whiskey one ounce every three hours. Strychnine gr. 1-60 t.i.d.

August 25. Patient somnolent and rather hazy, but answering intelligibly.

August 26. Loss of weight rapid.

August 27. Consultation with Dr. H. F. Vickery, who agreed to diagnosis of toxæmia and advised no change of treatment.

August 28. Effects of continued pyrexia manifest.

August 29. Left cheek swollen and dull red in color. On right side of scalp a palm-sized plaque, infiltrated, slightly elevated, dusky red, with abrupt, gyrate borders. Across upper half of thorax, erythematous, infiltrated area similar to scalp lesion, but twice as large.

September 1. Temperature 102. Pulse 110, unequal in size and intermittent every three to eight beats. Nourishment thus far well taken and retained.

September 4. Loss of strength more evident every day.

Nourishment retained, but patient obliged to be fed by the nurse. Several small bed sores apparent on back over scapulæ and sacrum. These are mere superficial breaks in the skin. Beginning dullness in right lung with bronchial breathing and coarse, moist râles. ℞ Air mattress. Alcohol baths, wash of carbolic acid, lime water and zinc. Powder of zinc.

September 6. General light bronze hue to skin. All nodules gone, leaving at their sites rounded maculations of a lighter color than the surrounding surface. Skin of extremities moderately thickened with coarse furfuraceous desquamation. Decubitus slightly more marked. ℞ Digitalis 1-40. Blood count: — Reds comparatively normal. Whites 36,000. Neutrophiles 70 per cent., small lymphocytes 23 per cent., large lymphocytes 6.5 per cent., eosinophiles 0.5 per cent.

September 7. Temperature 105.2. Pulse 130. Respiration 40. Abdomen moderately swollen and tympanitic. At base of right lung flatness and absence of respiration (atelectasis). Flatness not changed by position. Diffuse bronchial respiration in both upper lobes. Right base probably cut off by occlusion of bronchus. ℞ Strychnine 1-30, subcutaneously. Oxygen. Skin presented a general bronzing and a disappearance of all tumors. Death at 1:50 P.M.

AUTOPSY

by Dr. Oscar Richardson, of the Clinico-Pathological Laboratory of the Massachusetts General Hospital.

September 8, 1905. Nineteen and three-fourths hours post mortem.

Anatomical Diagnosis. — Mycosis fungoides. Fibrinopurulent pleuritis (right). Hyperplasia of the spleen. Hypertrophy and dilatation of the heart. Streptococcus septicæmia.

The body of a man, fifty-two years of age, 172.5 c.m. long, well developed and fairly well nourished.

Head. Not examined.

Trunk. The skin generally presents a peculiar brownish, glazed appearance and shows here and there small superficial losses of its substance, and in many places grayish patches covered with films of ointment-like material. In places, on handling the body, rather large superficial sheets of skin come off, leaving raw-looking surfaces.

In the anterior abdominal wall, just above the pubes, there is an irregular area of gray-white thickening in the skin several centimeters in greatest dimension. The surface of this area is rather irregular and slightly elevated above the level of the surrounding skin. On section the grayish-white tissue infiltrates slightly into the subcutaneous tissues. To the touch the wall of the scrotum is resistant and feels thickened.

On section subcutaneous fat in moderate amount. Muscles not remarkable.

The peritoneal cavity is free from fluid. The peritoneum is smooth and shining. The appendix not remarkable. The anterior margin of the right lobe of the liver is at the costal border in the right mammillary line.

Diaphragm. Right side, fourth rib; left side, fourth interspace.

The lungs are free. The bronchial lymphatic glands are not remarkable. The left pleural cavity contains no excess of fluid. The right pleural cavity contains a moderate amount of foul, opaque, purulent fluid material, supporting small flakes and masses of yellowish soft, fibrinous matter. On section the left lung shows nothing remarkable. The pleura of the lower half of the lung shows numerous smaller and larger masses of soft, yellowish, fibrinous material. On section the tissue of the upper and middle lobes is not remarkable. The tissue of the lower lobe over a considerable area is dark red in color and is infiltrated with a considerable amount of bloody fluid material. There is no evidence of consolidation. The bronchi leading to this lobe contain a considerable amount of soft, sloppy, fibrinous, purulent material which rests in some of the bronchi as flattened, shaggy masses.

Pericardium not remarkable.

Heart 386 grams. The myocardium on section is pale, cloudy and rather flabby. The left ventricle wall measures 12 m.m., the right 3 m.m. A teased preparation of the myocardium shows no evidence of increase of fat. The columnæ carneæ are fairly well marked. The mitral valve circumference 10 c.m., the aortic 7 c.m., the tricuspid 13 c.m. The valves are not remarkable. The cavities are of full size. The coronary arteries are free. The intima presents a few small fibrinous patches. The aorta is smooth.

Liver. 2295 grams. On section the tissue is pale, homogeneous and rather soft. No stones in the gall bladder. Bile ducts free.

The pancreas on section is not remarkable. The duct of Wirsung is free.

The spleen weighs 251 grams and on section shows a pale, fairly firm structure with well marked follicles.

Adrenals not remarkable.

Kidneys. Combined weight 467 grams. The organs are large. The capsules strip, leaving a smooth, pale surface. On section the tissue is rather soft. The markings are retained and the cortex measures 7 m.m. The section surface is pale and cloudy. The glomeruli are faintly visible.

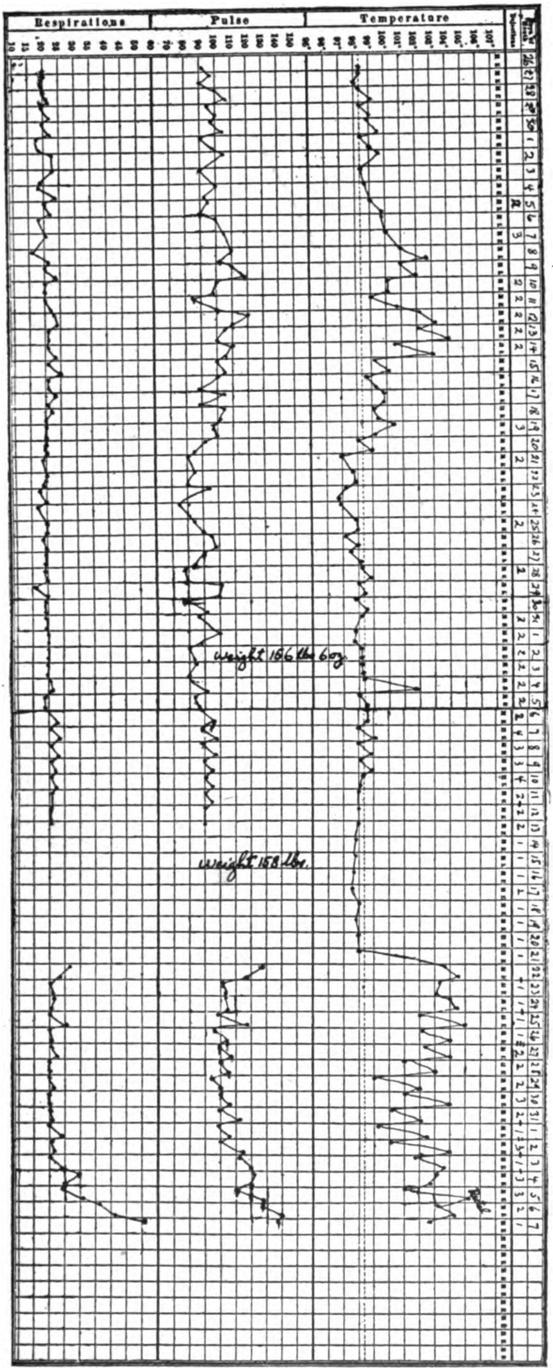
Ureters free. Bladder, prostate, seminal vesicles and testes on section show nothing worthy of note.

The œsophagus, stomach and intestines on section present no lesions. The retro-peritoneal lymphatic glands along the lower portion of the aorta and about the iliac vessels on each side are somewhat enlarged and on section their tissue is pale, cloudy and only fairly firm.

BACTERIOLOGICAL REPORT.

Cultures on blood serum.

Heart: Profuse growth of the streptococcus pyogenes.


Respirations
10
15
20
25
30
35
40
45
50
Pulse
60
70
80
90
100
110
120
130
140
150
Temperature
95°
96°
97°
98°
99°
100°
101°
102°
103°
104°
105°
106°
107°
Injections
weight 166 lbs 6 oz.
weight 158 lbs.

Liver: Profuse growth of the streptococcus pyogenes. A few colonies of a colon-like bacillus.

Spleen: Profuse growth of the streptococcus pyogenes.

X-RAY EXPOSURES IN DETAIL.

The application of the Roentgen rays was under the supervision of Mr. Walter J. Dodd, Director of the X-ray Laboratory of the hospital. The machines used were six inches and twelve inches in coil. About one-third of the exposures were given on the six-inch coil, which has a capacity on low tube of 0.5 milliamperes. The remaining two-thirds were given on the large coil with the capacity of 0.75 to 1.25 milliamperes.

PUBES			ARMS and SIDES				BACK			LEGS		
	Time	Distance		Time	Distance			Time	Distance		Time	Distance
June 29–	10m.	10in.	July 17–	10m.	10in.	L	July 19–	5m.	10in.	July 26–	10m.	10in.
July 1–	10 ,,	10 ,,	,, 19–	10 ,,	10 ,,	R	,, 21–	5 ,,	10 ,,	,, 28–	10 ,,	6 ,,
,, 3–	10 ,,	10 ,,	,, 21–	5 ,,	10 ,,	L	,, 24–	5 ,,	6 ,,	Aug. 1–	5 ,,	6 ,,
,, 5–	10 ,,	10 ,,	,, 24–	5 ,,	10 ,,	R	,, 26–	5 ,,	6 ,,	,, 2–	5 ,,	6 ,,
,, 7–	10 ,,	10 ,,	,, 26–	10 ,,	5 ,,	L	,, 31–	10 ,,	6 ,,	,, 6–	10 ,,	6 ,,
,, 10–	10 ,,	10 ,,	,, 28–	5 ,,	6 ,,	R	Aug. 1–	5 ,,	6 ,,	,, 9–	10 ,,	10 ,,
,, 12–	15 ,,	10 ,,	Aug. 2–	5 ,,	6 ,,	L	,, 2–	5 ,,	6 ,,	,, 14–	10 ,,	6 ,,
,, 13–	10 ,,	10 ,,	,, 4–	5 ,,	6 ,,	R	,, 7–	10 ,,	6 ,,	,, 16–	10 ,,	6 ,,
,, 14–	15 ,,	10 ,,	,, 5–	5 ,,	6 ,,	L	,, 9–	10 ,,	6 ,,	,, 18–	10 ,,	6 ,,
,, 17–	5 ,,	10 ,,	,, 8–	10 ,,	6 ,,	R	,, 18–	10 ,,	6 ,,	,, 19–	10 ,,	10 ,,
,, 24–	15 ,,	6 ,,	,, 10–	10 ,,	6 ,,	L	,, 19–	10 ,,	10 ,,			
,, 26–	10 ,,	6 ,,	,, 14–	10 ,,	6 ,,	R						
,, 28–	10 ,,	6 ,,	,, 17–	10 ,,	6 ,,	L						
,, 31–	10 ,,	6 ,,	,, 19–	5 ,,	6 ,,	R						
Aug. 1–	5 ,,	6 ,,	,, 21–	5 ,,	10 ,,	L						
,, 2–	10 ,,	6 ,,										
,, 4–	5 ,,	6 ,,										
,, 6–	10 ,,	6 ,,										
,, 8–	10 ,,	6 ,,										
,, 10–	10 ,,	6 ,,										
,, 16–	10 ,,	6 ,,										
,, 18–	5 ,,	10 ,,										
,, 21–	5 ,,	10 ,,										
220 minutes			110 minutes				80 minutes			90 minutes		

Total time of exposures eight hours and twenty minutes in the space of fifty-four days.

On examining the clinical chart it will be noted that there was a progressive rise of temperature from July 3 to July 8, when the thermometer registered 102.8° F. Then after a two days' remission another progressive and higher rise until July 13, when the fever reached 104° F. On comparing these dates with the x-ray table of exposures, it will be seen that the patient was receiving tri-weekly what would be called very moderate doses limited to the pubic region, and examining the clinical notes for this same period one finds nothing of any interest recorded. At the time, this elevation of temperature was interpreted as evidence of a possible mild septic absorption from the open pubic ulcerations.

PATHOLOGICAL EXAMINATIONS.

On July 3d a piece was excised from the pubes in the tumefied area contiguous to the largest ulceration. Post mortem, pieces of tissue from the same area were examined, both from the former tumefied portion and from the interlying healed ulcerations. These were all hardened in Zenker's fluid, imbedded and cut in paraffin and stained after various methods.

THE ORIGINAL TUMOR.

Before the application of the x-rays a piece of tissue was excised from the pubic region adjacent to the largest ulceration and the sections present the following characteristics:

Epidermis. The rete mucosum is slightly hypertrophic. The germinate layer is normal, but as we go upwards the cells become œdematous and stain lightly, and the epithelial interspaces are enlarged. The nuclei at first are clear and vesicular, but as we approach the upper strata the effects of œdema are more emphasized. Nuclei tend to disappear or to be surrounded by a clear space. Still more superficially the cells appear longitudinally flattened and entirely a-nuclear. Throughout the rete leucocytes are present, for the most part between the cells. The stratum granulosum and the stratum lucidum are absent; the stratum corneum is present, but contains nuclear débris.

Corium. The papillary layer is œdematous, contains dilated vessels and shows a moderate infiltration of lymphocytes. All of these structures lie in a very delicate meshwork. Below the papillary layer the corium is deeply invaded by the cellular growth. These cells consist almost entirely of large, vesicular, round, oval or irregular nuclei, containing a few chromatin granules, and surrounded by a minimum, almost undiscernible ring of cytoplasm. Mitotic figures are numerous. The recticular supporting skeleton of the corium is so very slight that it plays but a minor part in the histological structure of the tumor. In certain areas of the sections there are masses of very small mononuclear leucocytes, but as they appear in close proximity to the ulcer they are probably purely inflammatory in nature.

Blood vessels are numerous and, as a rule, tend to run vertically toward the surface of the skin. There are others, however, lying in irregular directions and these for the most part are dilated. The nuclei of these capillaries are mostly elongated and normal, but in some instances appear swollen and vesicular, yet stain clearly and sharply. The larger, dilated vessels contain a few leucocytes with one or more nuclei, while around them collagenous fibers, as a rule free from nuclei, appear in greater abundance than elsewhere in the sections. The dilated lymph spaces appear as elongated passages or square-shaped lacunæ, containing fine, coagulated, granular masses.

The elastic structures are wholly wanting in the papillary layer. Deeper down in the corium a few, scattered fibrils are present, for the most part short, thick and straight. A few, delicate, slightly wavy fibrillæ can be seen, always in minimum numbers.

THE TISSUES POST MORTEM, AFTER EXPOSURES TO THE X-RAYS.

A. Skin lying between the healed ulcers.

Epidermis. Under the low power of the microscope the elements of this layer appear rather blurred and indistinct. Under the high power, however, this diffuseness seems to owe its appearance to the great abundance of the rete nuclei, which occur so compactly that cell divisions are mostly obscured. The rete sends down numerous projections into the corium. On close inspection the palisade layer is ill-defined, its vertical, elongated cells being replaced by round, œdematous (?) nuclei. Above this layer the nuclei appear normal in structure, but comparatively increased in numbers, while the layer as a whole is thin and soon gives place to incompletely developed, nucleated, horny cells without the usual intervening stages of granulation. The horny layer is, nevertheless, thin, but not compact and shows in its lower strata vesicular nuclei. More superficially the nuclei become horizontal and the cells structureless. Leucocytes are not present in the epidermis.

Corium. The papillary and sub-papillary layers present a delicate reticulated structure, consisting of frail, a-nuclear collagenous elements supporting many large, coarse, ochre-colored pigment granules; numerous delicate, dilated capillaries with swollen nuclei; and abundant large, vesicular lymphocytes. In the deeper layers cellular elements recede markedly in numbers and in size and collagen appears in comparatively normal amount, but it is essentially a-nuclear. Even here lymphocytes are everywhere visible, but in very moderate quantities, and the cells are of the small variety. This cellular invasion presents a marked contrast with the solid, compact mass, obscuring practically all other elements, presented in the same pubic region before its many exposures to the x-rays.

The appendages of the skin are now evident and here and there hair shafts and sweat coils and their efferent ducts are to be noted. These structures are to all appearances normal, but the presence of small lymphocytes around them and in the neighborhood of the deeper vessels is more patent than elsewhere below the sub-papillary layer.

The panniculus adiposus is present and presents no abnormalities.

Elastin is present in remarkable abundance, except in the papillary and sub-papillary layers. Here it is practically wanting, but throughout the deeper layers of the corium, alongside the hair follicles, around the sweat glands and within the vascular walls the elastic fibers appear in great quantities. This superabundance of elastin is noteworthy compared with its almost total absence in the same region before its exposure to the x-rays. Some authors have alluded to this increase of elastic tissue subsequent to the exposure of the skin to x-rays.

B. The Healed Ulcer.

A piece was excised from one of the healed ulcers of the pubic region. Macroscopically this appeared as a flat, smooth, soft, very white tissue surrounded by the healed bronzed skin which had, under the influence of the x-rays, given place to the former tumefied masses.

Microscopically, the following conditions are present:

Epidermis. The layer as a whole, is somewhat thinned and flat, although on either side of the central point of the cicatrix it soon begins to form atypical, rudimentary interpapillary downgrowths into the corium. The rete is composed of a poorly developed germinate layer with vesicular nuclei containing well-marked nucleoli. Above this layer the cells are less typically shaped, stain poorly and show no prickles. These three or four rows soon give place to more horizontally lying, flattened nuclei which apparently take the place of the granular cells and soon are replaced by structureless horny cells which, for the most part, are a-nuclear, but contain here and there débris.

Corium. The papillary layer is absent. The sub-papillary layer is also not differentiable from the subjacent strata. Thus the connective tissue is to all intents and purposes uniform in structure and consists of a comparatively delicate, horizontal meshwork containing a relatively small number of poorly developed nuclei. Between the bundles of collagen appear a few, evenly distributed small lymphocytes, but farther away from the central point of the scar occasional large clusters of lymphocytes are present. In the upper layers of the corium small dilated vessels can be seen with normal endothelial linings. Deeper down, however, the veins appear with somewhat thickened walls and swollen endothelial cells. The sweat coils are poorly developed and their structure is very imperfect. The elastic tissues are also in greatly diminished amounts. In the upper layers of the corium elastin is seen only about the vessels, but deeper down it appears at irregular intervals as short, rather straight fibrillæ amidst the collagenous bundles. In the deep vessel walls, however, it again assumes its normal delicate, tortuous structure.

LITERATURE.

The literature upon the toxic effects produced by the x-rays is rather meagre, and I quote all the references which I have been able to glean from various sources.

Sterne[1] reports a case of toxæmia simulating acute sepsis. There was enormous enlargement of many glands which disappeared entirely under the influence of x-rays, but with the subsidence of the huge spleen and other glands, the septic condition developed, the patient became comatose, "convulsions set in and he died with every mark of violent sepsis, not only clinically but also microscopically, demonstrable through blood changes."

Pusey[2] records the appearance of a slight dermatitis and symptoms of toxæmia in a case of lymphadenoma after fifteen exposures to the rays. With cessation of the treatment the toxic symptoms disappeared, but were again in evidence after a renewal of the exposures.

Holzknecht[3] refers to three cases of fever and scarlatiniform dermatitis following exposures to Roentgen rays and mentions fever up to 40° C. as a very common sequela. He notes in addition concentrated urine and a universal or local exanthem, consisting of a small, pruriginous, maculopapular dermatitis, which exfoliates in a week and disappears after the lapse of a month or more. In conclusion, he states that the symptoms are due to the production of toxic material in the vicinity of the exposed skin induced by the specific irritant which leads to cell degeneration.

Kienböck[4] relates three similar cases in his experiènce.

J. Hall Edwards[5] writes that he is convinced that in certain cases of internal cancer the application of x-rays does much good; on the other hand, beyond the relief of pain the x-rays may do a large amount of harm, and death frequently has resulted from toxæmia, the result of the absorption of poisonous products set free by the rays.

Mr. Dodd of the Massachusetts General Hospital holds similar views and has told the writer that he can recall not a few instances in which people suffering from extensive internal and external carcinoma have gone to pieces very suddenly after being subjected to intensive x-ray exposures.

Edwards further states that as a means of overcoming this danger one should try the experiment of cutting down and draining a tumor after exposure to the rays, with the hope of combatting the absorption of poisonous products.

Allen[6] says that grave symptoms may arise with disintegration of large tumor masses under the influence of the x-rays, and we should watch the circulation and temperature carefully and stop treatment as soon as any alarming symptoms arise. And again, he states that at times we observe a toxic, febrile condition consisting of a high temperature with remarkably slight general febrile symptoms and a feeling of well-being which differentiates it from general toxæmia with or without exanthemata. This freedom from the usual accompaniments of marked hyperpyrexia was, for two or three days, one of the striking and remarkable features of the case now under consideration.

Gibson,[7] in speaking of the use of the x-rays in tubercular and malignant diseases, calls attention to the fact that in all deep and internal malignant conditions, especially where the disease is extensive, we have a septic state produced by the rapid disintegration of the diseased tissues of the tumor, the detritus being thrown into the circulation faster than the excretory organs can eliminate it.

Coley,[8] while describing the treatment of sarcoma with mixed toxins and x-rays, says that so far as danger is concerned it sums itself up into a judicious use of the agents so that too much of the neoplasm may not be liquified at once and unless this precaution is taken it is quite possible to make the patient extremely sick from septic absorption.

Nielsen[9] reports four cases of septic absorption and death following x-ray treatment. The first case was one of cancer of the breast followed by ulceration, toxæmia and death. The second, a sarcoma subsequent to a kick in the groin. After two months' treatment the patient died from toxæmia. The third case was one of epithelioma of the face, which made no favorable response to treatment, but succumbed to toxæmia. The fourth was a carcinoma of the uterus with a similar fatal termination. From such experiences Nielsen learned to be on the lookout for toxæmia in people of advanced age and in cases of recurrent growth.

Dock,[10] in referring to the treatment of leukæmia by x-rays, says toxic symptoms have been noted in several cases, but toxic symptoms are so common in this disease that it is impossible to tell how much the symptoms observed are dependent on the Roentgen rays.

Haret[11] records symptoms of toxæmia in three patients afflicted with cancer of the breast after treatment with x-rays. In the first case after four sessions (16 H units) the cutaneous nodules began to fade away, but the patient suffered from vertigo, palpitation, complete anorexia and insomnia, and some rise of temperature. Cessation of the exposures for ten days freed the patient from these toxic symptoms. After five séances (17 H units) the second patient developed violent headache, palpitation, loss of appetite, insomnia and extreme prostration. These distressing conditions subsided after withdrawal of the rays for two weeks, but began again on a resumption of the exposures. The third example occurred after four sittings (14 H units) and consisted of violent sickness, great lassitude, vertigo, anorexia, paroxysmal attacks of cephalalgia and precordial oppression.

In all of these cases the non-ulcerated nodules decreased in size after the exposures and Haret was led to believe that these symptoms were in reality toxæmic accidents. He would, in future, when treating non-ulcerated tumors of any size, produce a surgical wound on the skin to allow the escape of toxic matter.

Linser[12] finds that the x-rays destroy the leucocytes, especially the lymphocytes, in the circulating blood. As a result of this destruction a leucotoxin is produced and if a serum containing this leucotoxin be injected into an animal a destruction of the leucocytes will follow. With the leucotoxin it is possible to immunize against leucotoxin. The rays may in an indirect way produce nephritis, but do not affect the red blood cells or the hæmoglobin.

Franklin,[13] in speaking of the dangers of the x-rays, says that the general cachexia in cases of cancer treated by the rays has been too often remarked to require repetition, and the explanation — the absorption of the toxic products of cancer degeneration into the organism — as given by Holzknecht, is perhaps the correct one.

Lyle[14] (quoted by Haret in Le Radium, 1905, p. 314) believes that no one is justified in treating a tumor by x-rays unless drainage is established, and for this reason he does not consider it right to treat internal cancers by this method. Lyle bases these strong assertions on the fact that he has many times observed phenomena of intoxication which have sometimes been attended by the death of the patient.

Finally, allow me to quote from two personal letters which have been received from Dr. W. A. Pusey and Dr. W. B. Coley.

Dr. Pusey says: "I have constantly had this subject of toxæmia in mind because it has been broached many times. Personally, I have seen no toxic symptoms, except rheumatic pains, which could be attributed to too rapid absorption of neoplasms, and I have witnessed enormous tumors disappear under the influence of x-rays. Furthermore, I have not seen any case in the practice of other men, with the exception of a patient afflicted with extensive lupus vulgaris of the face and body. The areas were vigorously exposed to the rays and there was an acute x-ray reaction which rapidly disappeared, however. With this dermatitis a violent systemic reaction developed with a temperature of 105° F., a condition strongly suggestive of a tuberculin reaction. This toxic condition developed three times after renewed exposures to the rays and the third time proved fatal. I was for a long time skeptical as to any such toxæmia, but I think now that there is but little doubt that it may occur."

Dr. Coley states that in his own experience he knows of no case parallel to that which forms the subject of this present communication; nor is he cognizant of any similar case, "unless it be a patient who came under his care with a sarcoma of the mastoid region which he referred to Dr. Morton. The tumor disappeared rapidly under x-ray treatment, but the patient soon became cachetic and emaciated, and died in two or three months, death being due, he believes, to the slow absorption of broken down tissue."

From this résumé of the literature it will be seen that no instances of fatal toxæmia in cases of mycosis fungoides exposed to the Roentgen rays have been reported up to this time, but the study of this same literature reveals the fact only too clearly that henceforth x-ray therapeutists must conscientiously bear in mind, not only the hitherto well-known danger of dermatitis and atrophies, but the now clearly demonstrated and greater calamity of toxæmia and death.

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DESCRIPTION OF PLATES.

PLATE XVIII. Shows the pubic region some days after the beginning of the x-ray exposures. Also shows the already partial healing of the left ulcer and the thick folds in the left groin.

PLATE XIX. Shows the general distribution of the tumors on the back and arms.

PLATE XX. Fig. 1. Before x-ray exposure. Shows absence of stratum granulosum and parakeratosis of horny layer. Shows depth and character of cellular invasion and absence of all structures in the corium except blood vessels and cells.

FIG. 2. Before x-ray exposures. Pubic region. Shows the nature of the cellular growth, *i. e.*, lymphocytes, large and small. Shows the minimum amount of collagen present. Shows the dilatation of the vessels. (Histologically a round cell sarcoma.)

PLATE XXI. Fig. 3. Pubic region before exposure to the x-rays. Shows total absence of elastin. (Acid orcein.)

FIG. 4. Pubic region after exposure to the x-ray. Shows reappearance of elastin — perhaps an increased amount. (Acid orcein.)

PLATE XXII. Fig. 5. Pubic region after exposure to the x-rays. (Pigmented space between scars.) Shows the atrophy of the epidermis and the marked disappearance of the lymphocytes except in the sub-papillary layer and around the vessels, sweat glands and deep follicular region. Shows the reappearance of sweat glands and an incipient hair.

FIG. 6. Pubic region after exposure to the x-rays. (Non-pigmented scar.) Shows the atrophic epidermis and the dense fibrous tissue very free from the former intense cellular invasion.

ON THE BIER TREATMENT OF INFECTIONS AND SEPTIC WOUNDS OF THE EXTREMITIES.*

By E. A. Codman, M.D., *of Boston.*

During the last four months I have had the opportunity in the Out-Patient Department at the Massachusetts General Hospital to make a fairly extensive, though I must admit, somewhat superficial, test of the Bier treatment. During June, July, August and September I have been in charge of the male surgical room, and a goodly proportion of the average daily attendance have been cases in which this method of treatment has been applicable. The following brief remarks are in no sense to be taken for a scientific paper; I intend them for mere personal statements of my experience and resulting opinions. My opportunity at the hospital has been taken advantage of to try this treatment, and it seemed to me that perhaps some of the readers of the Journal might be interested to know what I think of it. It has seemed to me quite useless to present a long series of cases with detailed reports, for such cases present such an infinite variation in degree of severity and in individual idiosyncrasy that such reports would confuse rather than aid the reader. I suppose that every surgeon, as his experience grows, imagines that he can take better and better care of what we call "septic fingers" and "palmar abscesses." Certainly, during the last six services at the hospital I believe that my own results have been better and better, and it is possible that the excellent results this year have been due to my experience in the years which have gone before; but I frankly confess that I consider them due to the application of the Bier treatment.

At our own hospital ten years ago the ideal treatment of a septic finger, for instance, was to make a free surgical incision, down to the tendon or bone. Sometimes the finger was laid open as if split to broil and the tendon left bare in the middle. This was a period of reaction from the despised old-fashioned "medical incision." The result of the "split to broil" method was invariably loss of a portion of the tendon and frequently amputation of the finger. On the other hand, it was supposed that safety from general infection was secured; perhaps it was, but not infrequently while the tendon was sloughing out, the process again extended up the fiber, a new sheath became infected and the palm and perhaps the forearm had to be split.

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During recent years the treatment of these cases has been greatly affected by the example of Dr. C. A. Porter. Instead of the old-fashioned, blind, splitting operation in which the tendon was exposed willy nilly, Dr. Porter has applied a tourniquet and then with great care dissected down to the seat of the pus unhampered by the bleeding. By this method it is frequently found that the pus lies not in the sheath itself, but in the fatty and areolar tissue adjacent to it, the tendon, quite unimpaired, although, perhaps, lying in the closest proximity to necrotic fascia. He found that a careful excision of the necrotic part frequently saved the tendon if it were unmolested and not disturbed by gauze packing.

Thus his method gave safety from general infection by free drainage and yet minimized the damage to the tendon.

Now comes the Bier treatment. It is claimed that by this method the danger of general infection is lessened and at the same time the expulsion of necrotic tissue is aided. In other words it has the advantage over excision of the necrotic portions that it leaves all tissue capable of living, some of which the gross fingers of the surgeon must remove in his effort to excise the dead portions, and further it does not remove what inflammatory wall had already formed.

Suppose a case of septic finger: you fear two main things, — extension of the sepsis and future impairment of function. The Bier treatment claims to lessen both, — it prevents extension by mechanical congestion of the adjacent tissues and by increased pressure in the tissues it tends to throw off only the absolutely necrotic portions.

We all know that if we dare leave felons and boils alone that if they do not extend they heal with less damage than if we use a knife on them. If we knew they would not extend our only reasons for opening them would be to relieve pain or to hasten recovery. The "medical incision" suffices for the former and the hope of a more perfect recovery suffices for the latter.

A medical incision is by no means contra-indicated in the Bier treatment, and in my experience the recovery is more rapid than by incision and curettage.

We have applied the treatment in the following manner: When an old (*i. e.*, one who has been seen before) patient arrives in the morning his dressing is taken down and the wound examined and its condition recorded. A rubber strap two inches wide and provided with a buckle is applied about his arm or leg well above the lesion. This is drawn as tight as possible without stopping the pulse. The wound is covered with moist corrosive gauze and the patient sits down and waits an hour. The part is looked at from time to time to be sure that the circulation is not too greatly checked. At the end of the hour a moist dressing and splint is applied. The wound is not as a rule packed or drained. The same routine is followed each day.

After the first few minutes the pain is inconsiderable, and if pain has been present before it is usually relieved. Patients not infrequently bring a book or a newspaper to read during the hour. While the tourniquet is on the wound secretes more profusely, usually serum with particles of pus and necrotic tissue. In several cases after the treatment it was noticed that adjacent pockets had broken into the main one or on the surface. If slough presented at the surface of the wound we have not hesitated to pick it out, but on the whole delving and probing in the wound have been discouraged.

The nature of the cases in which we have used the treatment has been various. Almost all the cases of acute suppuration from whatever cause on the extremities has had the Bier treatment in addition to the usual dressings.

In some of the cases a fairly radical operation by Dr. Porter's method has been done, but in most merely a "medical incision." In a few, which I should in other years have incised, I have made no incision and the process has disappeared. On the whole, the cases which have done the best have been frank suppurations of the staphylococcus type, while the streptococcus or erysipeloid type has been less markedly affected. "Fish fingers" have not been particularly satisfactory, as they get well in time with no treatment.

In a number of cases it has been interesting to see that the affected finger remains stiff and swollen and edematous looking for many days after the treatment is stopped, but eventually normal motion has returned and the swelling has subsided. I imagine that in these cases there is a certain amount of gumming of the tendon sheaths with plastic lymph, which is gradually absorbed.

The Bier treatment in these cases seems to me to have many points of analogy with the Ochsner treatment of appendicitis. It seems to me that both aim to assist nature to build a barrier about the necrotic focus, and aim when this barrier is built to remove the focus. The application of either requires the judgment which comes of experience. As the Ochsner treatment has done much to aid pre- and post-operative treatment, I think the same will be the case with the Bier treatment. Evisceration and finger splitting belong to the same surgical era.

The comparison may also be carried to the question of pain. The patient undergoing Ochsner's treatment certainly is more comfortable than when his walling off was prevented with cathartics and the patient with Bier treatment is more comfortable than when his lymphatic spaces were opened up by the knife and curette. Perhaps in both we are again swinging to the old-fashioned medical treatment, but I am personally satisfied that the septic wounds of the extremities in my clinic this summer have done better in point of severity, pain and post-operative deformity than in previous years.

I must add, too, that my application of the treatment has been crude and given in a routine manner. It is not unlikely that varying the degree of pressure of the strap and the time of its application may still further improve its efficiency.

Finally, let me say that I have been very reluctant to admit the value of this treatment and began it with a strong prejudice against it. Nevertheless, I do not hesitate to indorse it to those who have not had as good an opportunity to try it. I believe it is safer in the hands of the inexperienced than an attempt at a radical operation, and that it is a valuable adjunct to the "medical incision," and *vice versa*.

FRACTURE OF THE BASE OF THE SKULL; MENINGITIS, OPERATION, RECOVERY.*

By J. G. Mumford, M.D., and H. C. Baldwin, M.D.

The patient of whom we shall make a brief report is not here to-night, but we feel that a statement of his case may be encouraging and instructive.

DR. MUMFORD.

On the 8th of September last the man was brought to the hospital by the police with the story that he had been picked up unconscious on the sidewalk. He is a vigorous man of fifty. There was blood oozing freely from his nose and left ear. From the examination and subsequent history I am confident that he was suffering from fracture of the middle fossa. No damage to the calvarium was apparent; there was no paralysis or abnormality of the reflexes; the patient moaned continuously and moved about his arms and legs. Within two days he became conscious, but was sleepy and morose; he was reasonably intelligent. By the end of a week it was evident that a progressive inflammation of the meninges was present. There was some fever, with a rising pulse, occasional delirium, increasing activity and headache; and at this time an examination of the left ear showed a perforation of the drum. Two weeks after the accident his condition remained about the same, except that he was weaker. Dr. H. C. Baldwin saw him with me at that time, and agreed that a septic meningitis was present. We decided to open the skull, seek for a possible abscess and establish drainage. In this case I turned back a large bone flap, going in over the left motor area, mainly because it seemed probable that the left hemisphere especially was affected, by extension from the left-sided base fracture, though there was no special evidence of motor involvement. At the time of the operation the patient was in bad condition with a rapid, feeble pulse, a low, irregular fever and muttering delirium. On exposing the dura it was found to be thickened and injected, bulging strongly against the sides of the opening in the bone. I turned back a large dural flap, when the subdural space poured out a cloudy serum and disclosed a deeply injected pia. The brain was everywhere markedly edematous, and pitted deeply under the finger like a rotten sponge. I carried the operation no further, as there was no indication of an abscess near the surface. I removed the bone flap and dura and replaced the flap of soft parts, after providing abundant rubber drainage. For two weeks after the operation the patient showed little change except that his pulse improved and the temperature gradually became normal. For three weeks the wound discharged an abundant sero-purulent fluid. The patient's mind continued cloudy, though he could be roused to answer simple questions, and he was restless and irritable. Four weeks after the operation the skin flap was bulging markedly, but this bulging gradually has subsided, until to-day there is no evidence of cerebral fungus. The patient is now in fair physical condition and able to go about, though his mind is still weak. The mental condition is improving, however, and we feel reasonably confident that he will recover completely under treatment at the Boston Insane Hospital, where he was sent last week.

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DR. BALDWIN.

Sept. 11, 1906, I was asked by Dr. Mumford to see the patient, as a matter of routine, and to pass upon the question as to whether there was a fracture of the base of the skull. The pupils were equal and reacted normally. There were no facial paralyses or paralyses of arms or legs. The reflexes were all normal. Mentally he was clear. In order to determine absolutely the question of fracture at the base, it was asked that the left ear be examined for rupture of the drum. Sept. 12 Dr. H. L. Morse reported that the left canal was filled with blood clot, the bony canal was very much narrowed and the drum membrane showed recent perforation.

Sept. 22 I saw him again in consultation, the patient having developed fever and mental symptoms. The pupils were not remarkable, the knee jerks and Achilles were normal. There was a question of Babinski on the left side, but no positive sign. Kernig's symptom was present. There was rigidity of the muscles of the neck. There were no facial paralyses and no paresis of arms or legs. The patient could be roused with difficulty, was partially cyanotic and presented a moribund appearance.

The diagnosis was made of septic meningitis with possible abscess in the temporal or occipital lobe on the left side, infection being through the crack in the ear. Immediate operation was urged, and was done by Dr. Mumford.

There was inflammation of the meninges and an edematous condition of the brain; there was no indication of any abscess.

Careful examination the day following the operation showed no weakness of the right face, arm or leg, and no aphasic disturbance.

The patient has recovered physically. He has been delirious and confused mentally ever since the elevation of temperature, which occurred before the operation. He has, however, moments when he is perfectly clear.

JACKSONIAN EPILEPSY DUE TO CYST OF THE BRAIN FOLLOWING INJURY. SUCCESSFUL OPERATION.*

By Henry C. Baldwin, M.D., and J. G. Mumford, M.D.

DR. BALDWIN.

P. R., twenty-one years; fireman on a locomotive; single.

May 11, 1906, the patient came to the accident room of the Massachusetts General Hospital for a burn of the face received by falling against the fire-box of his engine in an epileptiform attack. He was referred to the neurological department and gave the following history. Two years previous, while climbing on to his engine, he hit his head against a pulley. There was no scalp wound. He was dazed for a moment, but not unconscious. About fifteen minutes later his right arm began to twitch and he became unconscious. There was no general convulsion. Five weeks later he had a second attack, and between that date and the time he came to the hospital he had had half a dozen spells. Most of these spells were attacks of twitching of the right arm or hand; in one or two he had become unconscious.

He was recommended by Dr. Walton, to the hospital for operation but did not follow the advice.

June 25 he came again to the Out-Patient Department in my service with the history of having had several of these attacks in which he had not lost consciousness, but in which he had twitching of his right arm. The danger to him personally was pointed out, and he was sent into the house for observation and operation. He remained in the house about three weeks without having any attack, and left the hospital at his own request July 17. He was told to return immediately if he had any attack. Three days later he returned stating that he had had three attacks of twitching in his right hand in which he did not lose consciousness. The first of these attacks lasted several minutes, was followed by a second in about half an hour and the third in about two hours. He was sent into the house at once for operation. The diagnosis was Jacksonian epilepsy due either to the irritation of a spicule of bone or to a cyst following a hemorrhage at the time of the injury. Physical examination at this time showed normal reflexes and no loss of muscular strength anywhere.

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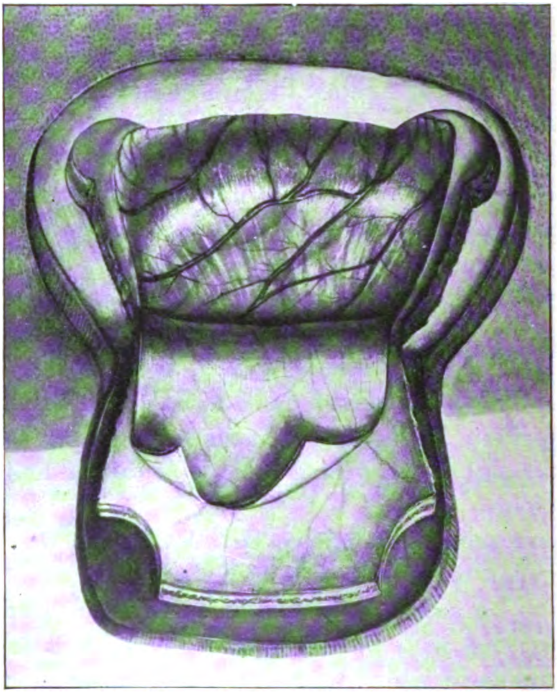
* Read at the Clinical Meeting of the Massachusetts General Hospital, Nov. 9, 1906.



Sketch of cyst, made at time of operation.

The operation was performed by Dr. Mumford July 28, and showed a cyst over the arm center on the left side. The patient was examined carefully the day following the operation for paralyses, which so often follow exposure and operations on the cortex of the brain. There was no loss of muscular strength in the right face, arm or right leg, and all the reflexes were normal. The patient has made a perfect recovery and has had no return of these attacks up to the present time.

DR. MUMFORD.

A word about the technique of the operation: I prefer to use the head tourniquet for control of hemorrhage in the skin and to expose a large area of the cortex. Accordingly I turned back with the skin a bone flap nearly as large as my palm over the left parietal region, making a bevelled edge to prevent sinking in of the bone flap should I decide to replace the bone. The dura was found quite adherent to the calvarium and was somewhat torn in cutting out the bone, which was done with the DeVilbiss osteotome. Then the dura over the whole exposed area was turned back, disclosing a bluish-white, bulging area over the whole region, apparently a thin walled cyst beneath the pia. This cyst, if one may so call it, was too extensive and elusive for excision. I opened it in three or four places, however, and allowed the escape of a considerable amount of sero-hemorrhagic fluid. Before opening the cyst there was an appearance of marked intracranial tension, which subsided with the escape of the sero-hemorrhagic fluid. Surgeons have debated the further treatment of the wound in these cases, — whether to restore the parts with the bone flap, or to remove the bone for decompression of the brain. Kochner's reported cases of decompression encourage one, however, to remove the bone flap, and I did this in the case under discussion, restoring the flap of dura, however, and sewing up the skin-wound, with drainage.

For some days after the operation there was abundant oozing through the drainage openings, but in the course of two weeks the wound had healed completely. The patient was kept quietly in bed for four weeks, and a week later was discharged, there having been no positive evidence of furthur epileptic attacks during his stay in the hospital.

It is now fifteen weeks since the operation. The patient has continued in vigorous health, as you see him here to-night.

A CASE OF CONGENITAL OCCLUSION OF THE SMALL INTESTINE. OPERATION. AUTOPSY.*

By Lincoln Davis, M.D.,
Instructor in Anatomy, Harvard Medical School; Out-Patient Surgeon, Massachusetts General Hospital.

AND

Oscar Richardson, M.D.,
Assistant Pathologist, Massachusetts General Hospital.

On account of its comparative rarity and the problems involved in its pathogenesis, this case seems worthy of record.

Clinical History. — On Dec. 11, 1905, about 6 P.M., an infant twenty-six hours old, with a history of having passed nothing by rectum since birth, and of having vomited dark greenish material quite constantly during the last few hours, was seen in the accident ward of the Massachusetts General Hospital.

The baby had been sent to the hospital by Dr. D. J. O'Shea, of East Boston, with the diagnosis of intestinal obstruction. It was afterwards learned from Dr. O'Shea that the birth was in every way normal. The parents were well and strong. No history of tuberculosis or specific disease. There had been five other children in the family, one of whom died in infancy of marasmus, the others are living and well. This baby was born at full term at 4 P.M., on Dec. 10, and nothing was noticed to be wrong with him until the next morning, when there had been no movement of the bowels, and vomiting began.

Examination at the hospital showed a well-developed male infant without external malformation. The heart action was quite rapid. The abdomen was greatly distended and tense, presenting two distinct transverse bulgings and a sulcus between, across which peristaltic waves periodically passed. The abdomen was generally tympanitic. Nothing in the way of a tumor was to be felt. A soft catheter was passed without difficulty into the rectum for a distance of three inches; repeated injections of warm water failed, however, to bring away any fecal matter.

The history of complete obstipation, the vomiting of matter resembling meconium, together with the signs of abdominal distention and visible peristalsis, made the diagnosis of intestinal obstruction seem certain. The nature of the obstruction, however, was not conjectured.

Reprinted from the Boston Medical and Surgical Journal, Vol. cliv, No. 10, pp. 266-269, March 8, 1906.

Operation. — An operation was decided upon and, under ether, an incision to the right of the median line made through the abdominal wall. Upon opening the peritoneal cavity, greatly distended small intestine popped out, an adhesion partially constricting a coil of distended intestine was freed; the gut, which was much distended beyond this point, was followed down and found to end in a free blind sac. Continuing the exploration a mass was felt in the right flank adherent to the lower edge of the liver. When this was lifted up into view, it was seen to be composed of fine coils of undeveloped intestine held together by adhesions, and resembled closely a mass of earth worms. This mass was dropped back, and the greatly distended upper segment of intestine was tapped with a trocar, with the evacuation of a considerable amount of gas and semi-fluid greenish material. The blind end of the intestine was then sutured into the wound and the opening in the gut enlarged.

The baby stood the operation fairly well. There was very little fecal discharge from the artificial anus, but some oozing of blood. Attempts to give salt solutions by rectum were unsuccessful; after one rectal injection a stringy white cast was passed. There was occasional vomiting. The baby gradually failed and died twenty-four hours after the operation.

Autopsy. — Permission was obtained for a post-mortem examination and the following conditions were found to be present:

The body is that of a male infant, forty-eight hours of age, 45.5 cm. long, well developed, fairly nourished.

Head: Not examined.

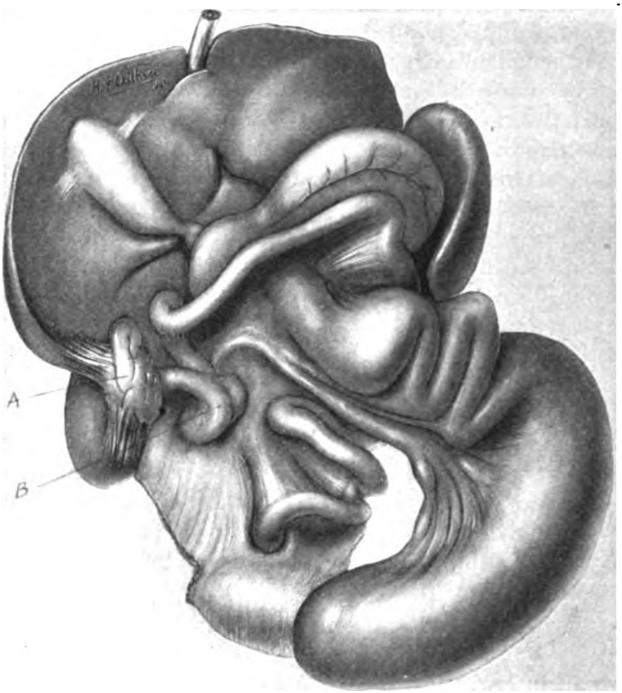
Trunk: The thoracic viscera and cavities on section are normal.

On the right side of the abdominal wall there is a linear wound 5.5 cm. in length closed with sutures.

The peritoneal cavity is free from fluid. The serosa of the intestines near the wound of operation is blackish red in color and shows here and there a slight amount of grayish soft exudate. In one or two places the coils of the small intestine are slightly glued together by grayish soft exudate. In what is apparently a free blind end of the small intestine there is a surgical opening. The base of the umbilicus is normal.

The liver, stomach, pancreas, spleen, kidneys and adrenals on section are normal in appearance and have the normal anatomical relations. The duodenum is distended, but otherwise is normal in appearance. Bile flows from the duodenal papilla on

FIG. 1.



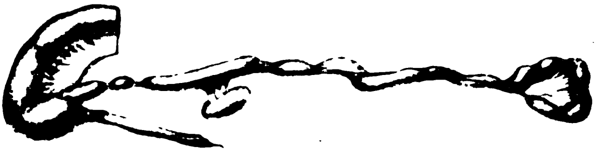


FIG. 2.

FIG. 1. — The drawing shows the distended jejunum and ileum with the first portion shortened up to show the free blind end of the intestine and the free mesenteric border.

Attached to the liver and kidney on the right side, the small mass of shrunken coils of the ileum is well shown, A.

A little to the left and below this mass the lower end of the ileum, the cecum and a portion of the appendix are seen, B. The course and size of the large intestine are well indicated.

FIG. 2. — Shows portions A and B as they appeared when dissected out with the coils unravelled; the former is seen to consist of a constricted segment of ileum ending blindly, and the latter of a well-formed cecum and appendix.

pressure of the gall bladder. The gall bladder is normal in appearance and free from stones. The duodenum measures in circumference 4 cm. and is continued as the jejunum with normal anatomical relations. Of this portion of the small intestine there is present, however, only a distended portion of the tube measuring about 46 cm. in length, and varying in circumference from 4.5 cm. to 7 cm. The mucosa shows strikingly well-marked rugæ more prominent towards the distal end of the tube. The contents of this part of the intestine consists of a soft dark greenish-brown material. The portion of the jejunum present ends blindly and shows in its free blind end the surgical opening previously referred to. It is supported by a crescentic flap of mesentery which averages about 2 cm. in width and which springs from the usual situation of the root of the mesentery. The margin of the mesentery away from the intestine is free, smooth and rounded and in several places in it small lymphatic glandlike bodies are visible.

The rectum, sigmoid flexure, descending colon, splenic flexure, transverse colon, and hepatic flexure have their normal anatomical relations and on section show no lesions of the mucosa. The large intestine contains a considerable amount of pale, gelatinous, mucous-like material and measures in circumference from 1.5 cm. to 2 cm. In the situation of the hepatic flexure the colon turns down and reaches to a point at the level of the lower pole of the right kidney at which point there is a small pouchlike dilatation. From this portion of the colon a smaller tube continues, extending upward and over across the ascending colon where, just to the right of this and a little above the distended pouchlike portion of the colon, it is lost in what is apparently a complicated coil of intestine. This knotlike mass of intestine, which measures 2 cm. by 1.5 cm. by 1 cm. is bound by fibrous tendinæ-like adhesions to the inferior surface and lower margin of the right lobe of the liver and to the peritoneum over the perinephric tissues in the region of the lower pole of the right kidney anteriorly. Where the small portion of intestine continues from and over the ascending colon there is a short prolongation along it of the mesentery from its root. On unravelling the complicated coil of intestine it is found to be made up of a length of the lower end of the ileum about 15 cm. long. This portion of the small intestine ends blindly in the coil and the other end joins the pouchlike portion of the ascending colon, which is in the situation of the cecum, with the same anatomical relations that it has in the adult. On section the ileo-cecal valve has its normal relations. Springing from the base of the pouchlike portion of the ascending colon or cecum there is an appendix-like organ the distal half of which is bound by fibrous-like tissue along and to the ileum. This appendix-like tube measures about 4 cm. in length and averages about 3 mm. in diameter. Water passes through the large intestine until it reaches the cecum where it passes into and distends the appendix. The water also passes into the small intestine over a length of about 1 cm. above the ileo-cecal valve. Here the small intestine is constricted and occluded by fibrous-like tissue. From this point on the portion of ileum present is more or less constricted at irregular intervals by fibrous-like connective tissue which broadens out in places into a membranous-like band which is inserted all along the wall of the ileum similar to the insertion of the mesentery in the wall of the ileum in the adult. The ileum is quite small, being about 4 mm. in diameter in its largest portion. About 5 cm. above the ileo-cecal valve there is a small mass of tissue which measures 1 cm. by 5 cm. by 3 cm., and is attached to the wall of the ileum by fibrous tissue. The mass is possibly gland tissue or a small piece of the ileum separated in uncoiling the knot of intestine. A piece is put away for microscopical examination. On section of the small intestine, where possible, no lesions are made out, but there is in portions of its lumen a slight amount of yellowish, soft mushy material.

There is no good evidence of the presence of a Meckel's diverticulum anywhere along the course of the small intestine.

The ureters, bladder, prostate and testes are normal in appearance and have their usual anatomical relations.

Microscopical examination of one of the mesenteric lymphatic glands and of the small mass of tissue attached to the ileum shows nothing remarkable. The mass is regarded as being a small portion of the ileum separated off in untangling the coil of intestine.

From the above findings the case is clearly one of congenital malformation of the small intestine with complete interruption in the continuity of the intestinal tube and consequent intestinal obstruction.

Occurrence.—A somewhat limited review of the literature of the subject reveals quite a collection of recorded cases of congenital abnormalities of the upper intestinal tract. These abnormalities vary in degree from stenosis and stricture to complete obliteration and severance of the alimentary canal. In some cases the blind ends of the gut are connected by an impervious fibrous cord; more rarely, as in our case, there is no connection between the two ends. A few cases have been reported where a segment of the bowel has been actually missing. These malformations are often multiple and in some cases are accompanied by other congenital defects, such as umbilical or inguinal hernia, atresia of the anus, hypospadias, etc.

The most common site for congenital intestinal atresia, excluding, of course, the rectum and anus, is in the vicinity of the ileum or at least within the primitive intestinal loop, and next in frequency in the duodenum. The form of defect illustrated by this case, that is, complete severance of the canal without connection of the blind ends, although reported in a few instances in the duodenum, is much commoner in the lower jejunum and ileum.

Gaertner, in 1883, collected 64 cases of stenosis or atresia of the small intestine. There were 27 in which the intestine had a blind ending, though in some of these the ends of the gut were connected by an impervious cord. Of these 27, 9 were in the duodenum, and 16 in that portion of the intestine corresponding to the primitive loop.

Since then quite a number of additional cases have been reported by various observers, and cases identical to ours have been reported by Lillienfeld and Archambault.

Braun, in 1902, collected 25 cases of congenital occlusion of the ileum or jejunum which were operated upon, all with fatal results. In one case there was survival for fifteen days after the operation. There have been a few operative cases reported since then with a like result.

Pathogenesis.—As to the cause of congenital occlusion of the upper intestinal tract, many theories have been advanced, and some striking cases cited in their support. Probably no one theory can explain all the cases.

The most prominent theories are that these defects are due to the results (1) of fetal peritonitis; (2) of volvulus; (3) of compression or snaring of a portion of the gut by the closure of the cavity of the umbilical cord.

The latter theory was first elaborated by Ahlfeld, in 1873, who ascribed such defects to an abnormal persistence of the vitelline duct, whereby the loop of intestine which in the course of development enters the cavity of the umbilical cord, is prevented from returning to the abdominal cavity at the proper time, which results in its being pinched or snared off, as the case may be, by the closure of the abdominal walls. This theory accounts for those cases in which a segment of the intestine is entirely lacking. By an ingenious elaboration of the same theory, Ahlfeld includes atresia of the rectum and anus as secondary results of the undue persistence of the vitelline duct due to traction on the intestine. He records a case which seems to confirm his theory, and similar cases have been reported by others, notably by Clogg. This theory has, on the whole, been quite generally accepted.

That volvulus within the abdominal cavity during fetal life may result in atresia cannot be denied, and that this result may even take place in adult life under peculiar conditions seems to be shown by the remarkable case reported by Hädlich.

That other causes also may be productive of these defects seems to be shown by scattered reports of cases in which invagination of the intestine, disease of the mucosa, or the pressure of a tumor have been the causative factors.

The conditions found in the case here reported are most satisfactorily explained by a strangulation of a portion of the intestine, together with its mesentery, which resulted in a complete severance at one point, and an atrophy and non-development of that portion which had been partially deprived of its mesenteric blood supply. It is evident from the absence of bile-stained matter within the intestine below the site of occlusion, that the lesion occurred early in fetal life before the establishment of biliary secretion, that is, before the end of the third month. The remarkable changes in position of the primitive loop of intestine at about this same period in connection with its migration into the cavity of the umbilical cord, and its withdrawal therefrom, would seem to offer a most favorable opportunity for such strangulation. This seems to us the most plausible theory by which to explain the conditions found in this case. The adhesions and enlargement of the mesenteric glands may be fairly considered as the result of inflammatory reaction due to the strangulation.

Treatment. — As to the treatment of this well-nigh hopeless condition, the formation of an artificial anus seems the only solution. An intestinal anastomosis between the dilated portion above, and the shrunken gut below the occlusion, offers insurmountable technical difficulties. Braun makes a very good suggestion in proposing to bring out both blind ends of the intestine through the wound; this would allow of forcible dilatation of the distal segment by means of injections from above, and the performance of an intestinal suture outside the abdominal wall at a later date if occasion offered. A suggestion of J. W. Elliot for maintaining nutrition in cases of fistula high up in the intestinal tract by catching the intestinal contents from the afferent segment and injecting them into the efferent, would seem particularly applicable to such cases.

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The articles of Braun and Clogg contain excellent bibliographies.

THE BONE METASTASES OF HYPERNEPHROMA.

A REPORT FROM THE MASSACHUSETTS GENERAL HOSPITAL CLINIC.*

By Charles L. Scudder, M.D.
Surgeon to the Massachusetts General Hospital.

Previous to 1883 new growths of the kidney were not very accurately differentiated. Lipoma, sarcoma, adenoma, adenocarcinoma, angioma, angiosarcoma, myxoma, endothelioma, were a few of the terms applied to kidney tumors.

In 1883 Grawitz[1] described a tumor of the kidney similar in structure to the adrenal and traced its origin to adrenal tissue.

Birch-Hirschfeld, in 1896, called these tumors arising from adrenal tissue, hypernephromata. The term hypernephroma, therefore, is applied to all tumors of adrenal origin. They may arise either from the normally-seated adrenal body or from ectopic fragments of the adrenal body, the so-called adrenal rests. Because of the very intimate developmental association of the adrenal body and the genito-urinary apparatus bits of adrenal tissue are frequently found included within certain organs, notably the kidney, the ovary, the testicle, the uterus. Thus is explained the occurrence within these organs of tumors resembling adrenal tissue.

In size, a hypernephroma may be as small as a pea or as large as a child's head. It is not uncommon to discover, at autopsy, tiny adrenal kidney rests which have remained in the kidney without causing symptoms. A hypernephroma, developing slowly in the kidney, may remain symptomless for years. Finally it may grow rapidly and become malignant. Malignancy manifests itself in three ways: (1) By local destruction of tissue after breaking through the capsule; (2) by metastases; and (3) by a general toxæmia.

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*Note—I wish to thank my colleagues of the Surgical Staff who have permitted me to record here cases occurring in their hospital services. Reprinted from Annals of Surgery, December, 1906.

[1] Virch. Archiv., xciii, 39, 1883.

The important symptoms and signs of a hypernephroma are hematuria, renal colic and tumor.

Hematuria is occasioned by hemorrhage from the new growth which has extended into the pelvis of the kidney. Hematuria is variable in time and quantity. Hematuria appears at intervals and lasts but a short time. The absence of hematuria does not mean that the kidney is free from the growth. In the case here recorded hematuria is absent and yet the tumor is present.

Renal colic is caused by the passage of ureteral blood clots. Pain may be occasioned by the stretching of the tumor capsule. In the case here recorded there has been no pain referable to the kidney or loin. The tumor may be discovered, as in the present case, before any other sign of the kidney lesion is present. The general pallor of the present patient is characteristic. Blood changes, other than a low hæmoglobin, are not present.

The metastases of the hypernephromata are most interesting. Neusser calls attention to the fact that apparently benign hypernephromata are capable of giving rise to metastases larger than the primary growth. Metastases are found most often in the lungs, the liver and the bones. Almost any of the tissues of the body may be invaded. It is generally thought that the mode of metastasis is through the blood by way of the renal vein. Extension is thought to occur rarely through the lymphatics. Many specimens exist in which the growth is seen extending directly into the renal vein.

In my service at the Massachusetts General Hospital, during the past three years, there have been three cases of hypernephroma. I wish to record in detail one of these cases (Case XI of the M. G. H. series), as it is of especial interest:

Case XI. — Massachusetts General Hospital, No. 144,138. September, 1905. J. J. A., a man thirty-four years old. Has always been well and strong. For eleven months he has had pain and discomfort about the

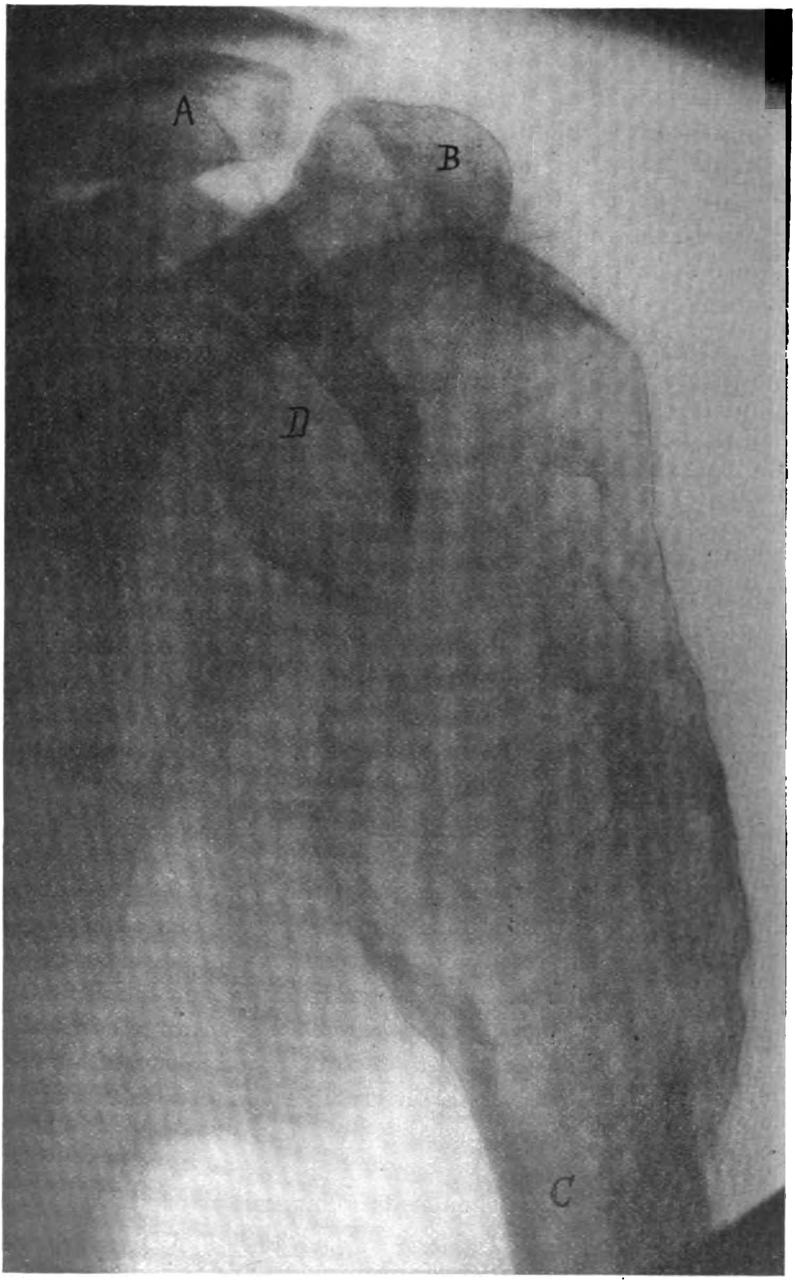

FIG. 1.—Case XI: X-ray of upper end of humerus, showing region of tumor, D, C. A, Clavicle; B, Acromion; C, Shaft of humerus; D, Head of humerus.

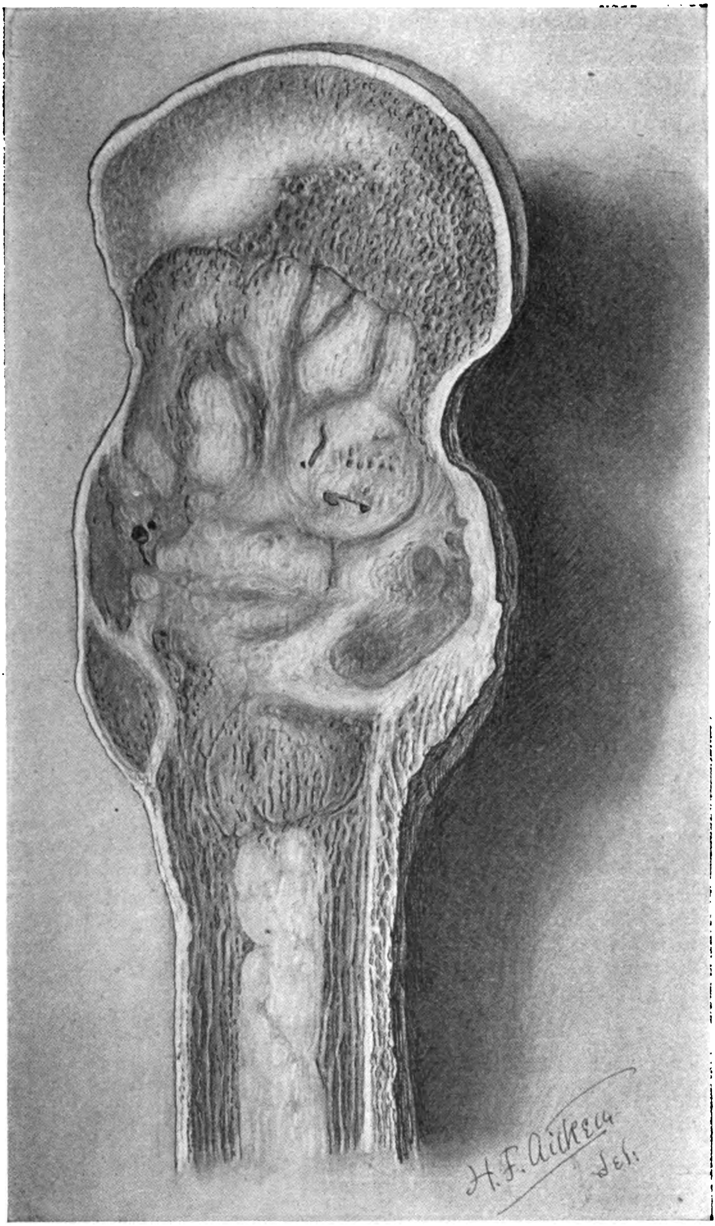

FIG. 2.—XI: Hypernephroma, metastatic in upper end of the shaft of the right humerus. Drawing made from a section of the gross specimen.

right shoulder joint. The shoulder has been sore and stiff. The impairment of motion has been in the extremes of movement. There is an atrophy of the scapular muscles. At the upper end of the shaft of the right humerus is a tumor, which is not particularly tender upon pressure.

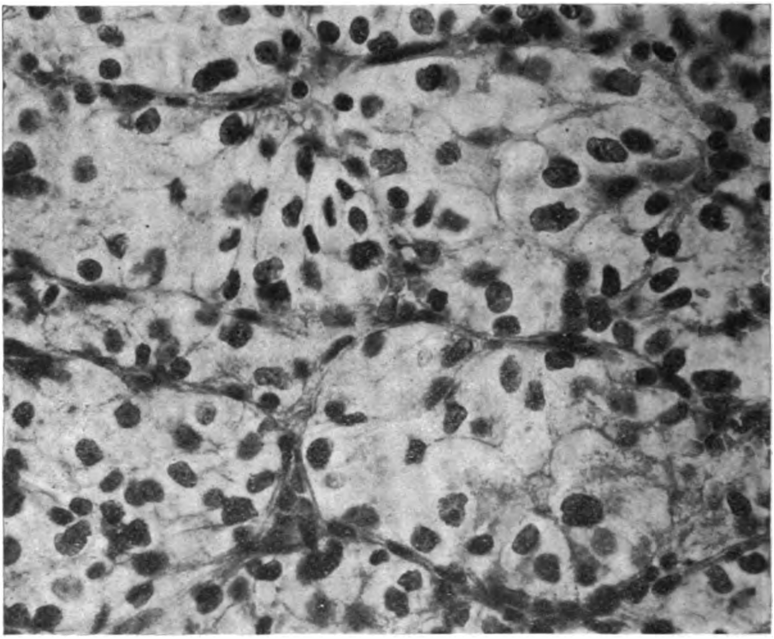

FIG. 3.— Case XI: Microphotograph of a section from metastatic hypernephroma in upper end of humerus. Oval polygonal cells — preservation of rim of cytoplasm, deeply staining nucleus, perinuclear lightly staining spaces. Microphotograph by Mr. Brown, M. G. H. Laboratory.

The x-ray defined the tumor accurately. (See Fig. 1.) Before operation it was thought to be a sarcoma of the humerus. An amputation at the shoulder joint determined that the joint was uninvolved by the disease. The microscopical report discovered that the growth was a hypernephroma. (See report.)

Palpation of the abdomen after operation discovered for the first time a slightly movable and enlarged left kidney. There were no signs or symptoms attracting attention to the kidney. The urine was normal.

The man recovered from the operation. Recent examination one year after the operation finds the man in fair health and about as well and strong as usual, although he is extremely pale and cachectic-looking.

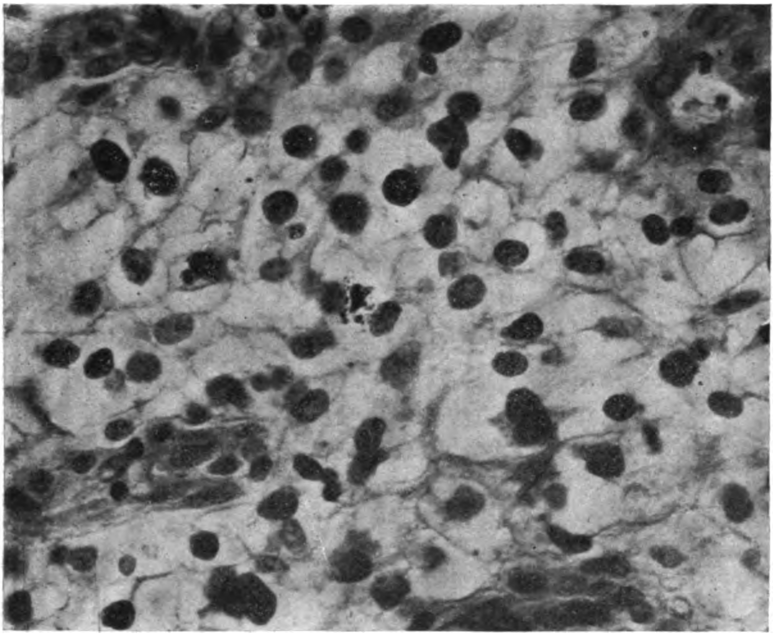

FIG. 4.—Case XI: Microphotograph of a section from metastatic hypernephroma in upper end of humerus. Higher power than in previous plate, No. 3.

Pathological examination and report by Dr. C. C. Simmons. The specimen consisted of the whole upper extremity, including the head of the humerous (see Fig. 2). On section at the surgical neck there was a fracture through the tumor mass. Occupying the shaft beneath the surgical neck and extending from the head downwards for 6 cm. was a soft grayish-white new growth which had distended the medullary canal and absorbed the greater part of the cortex. The bone at the center of this growth was

5 cm. in diameter. No infiltration of the soft parts could be made out, and the growth did not involve the shaft of the bone below the site of the main tumor.

Microscopic examination (see Figs. 3 and 4) showed solid masses of large round cells having an alveolar arrangement and separated by many fine blood-vessels and fine bands of fibrous tissue. The cells were round, with somewhat vesicular nuclei and a comparatively large amount of clear, fatty degenerated protoplasm having a definite outline. The tumor represents a sarcoma and is

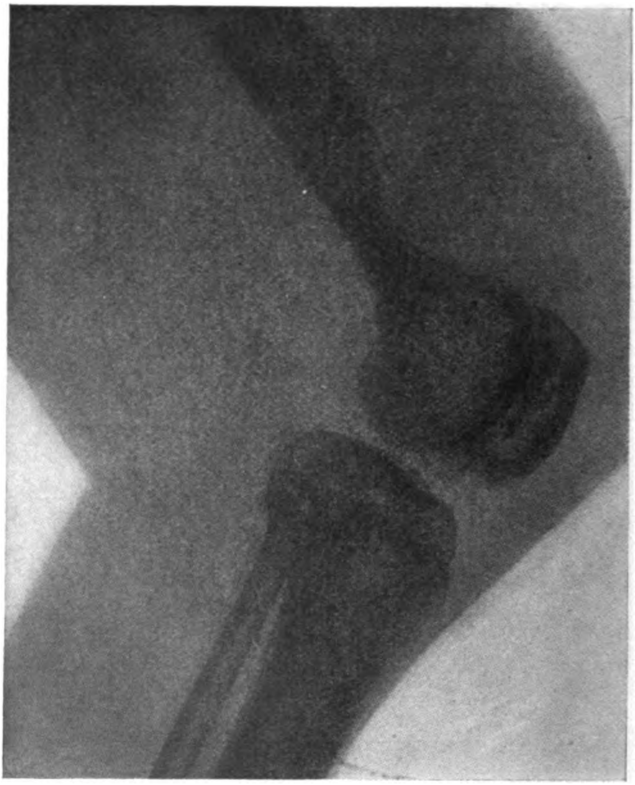

FIG. 5.— Hochenegg's Case No. 4: Reported by Albrecht. 60 years old. Radiograph. Hypernephroma of femur. Spontaneous fracture of femur. Amputation of thigh. 5½ years subsequently tumor of kidney apparent. Complete autopsy. Metastases elsewhere.

highly suggestive of metastasis from a hypernephroma. Sarcoma (hypernephroma).

It was thought, at the time of examination and previous to operation, that this tumor of the upper end of the humerus was a sarcoma.

In a paper, "A Study of Certain Cases of Sarcoma of the Long Bones, from the Massachusetts General Hospital Clinic," published in the *Boston Medical and Surgical Journal* in June, 1904, the conclusion was reached that in cases of sarcoma, amputation at the joint above the disease is wise, if the disease is high in the shaft, and limited. Consequently, in this case amputation at the shoulder joint was done. A fact of interest connected with this case is that the tumor of the humerus was the first evidence or sign of the disease.

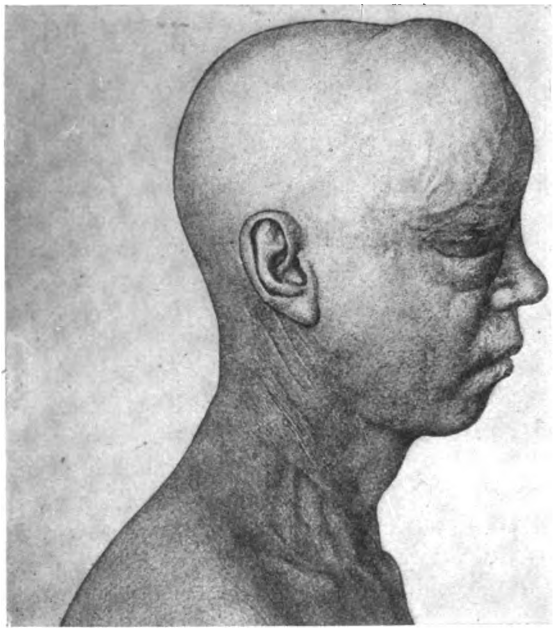

FIG. 6.— Hochenegg's Case No. 7: Reported by Albrecht. 42 years old. Hypernephroma of parietal and frontal bones. Death, complete autopsy.

Certain questions of practical importance arise: What is the proper attitude toward this kidney-tumor, as yet manifesting no sign? Shall it be removed by nephrectomy? If it is removed what will be the prognosis?

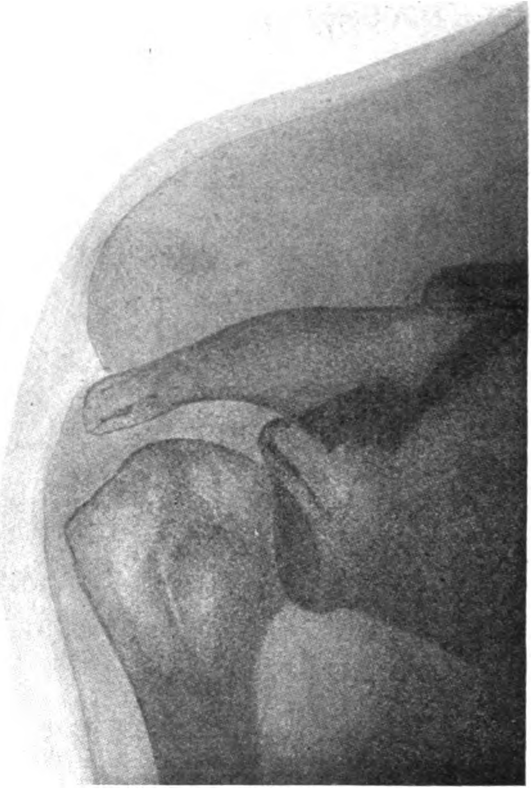

Fig. 7.— Hochenegg's Case No. 16: Reported by Albrecht. 66 years old. Radiograph of hypernephroma of clavicle.

The very great proneness of the hypernephromata to metastases, as demonstrated by autopsy reports and the fact that the metastases are usually multiple, would lead one to give an unfavorable prognosis in this case were it not for a series of very careful observations by Albrecht[1] from Hochenegg's clinic in Vienna.

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[1] Arch. f. klin. Chir., 1905, lxxvii, 1073; with bibliography.

Albrecht finds that in two cases of Hochenegg, in which complete autopsy returns have been made, the bone metastasis was the *sole* metastasis. This observation is of importance. These cases were as follows:

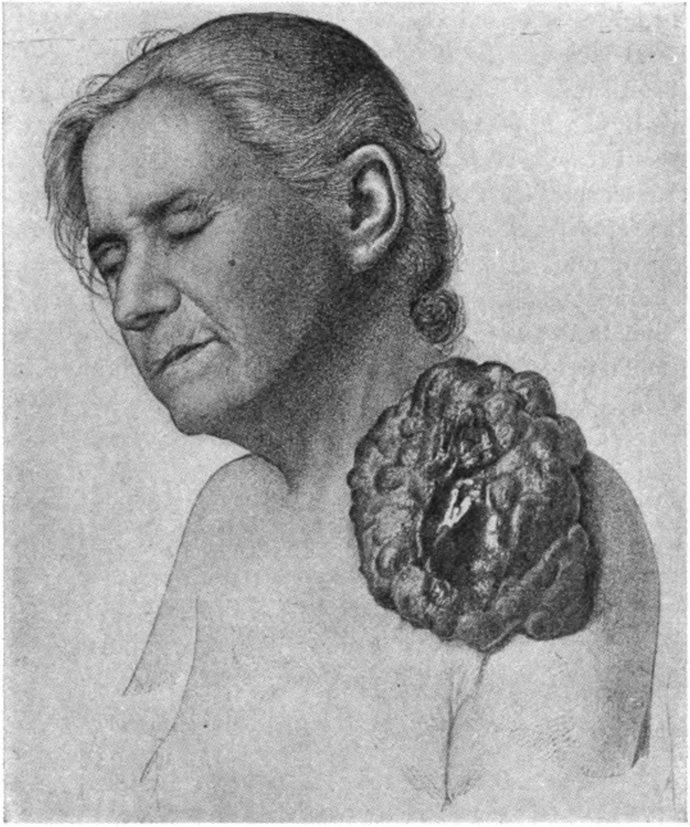

FIG. 8.—Hochenegg's Case No. 16: Reported by Albrecht. 66 years old. Hypernephroma of clavicle recurrent.

Hochenegg (reported by Albrecht), Case II, a *skull sarcoma*, was operated upon and died. A complete autopsy showed no other metastases. Case V, a nephrectomy. Four months following the nephrectomy a metastasis appeared in the *occipital* bone, and six months after the appearance of this metastasis a complete autopsy found no other metastases.

In view of these observations of Albrecht it is possible that in the case reported the metastatic growth in the humerus is the only metastasis present. If so, nephrectomy is indicated.

In collecting and studying certain of the cases of hypernephromata which have appeared at the Massachusetts General Hospital Clinic, I find, all together, eleven cases. A careful microscopical study of each of these cases was made by Dr. Whitney or Dr. Wright or Dr. Simmons. The end results are known in all of these cases. Excepting the case here recorded, all of these patients are dead or are reported (two of them) dying. Such is the mortality of the malignant hypernephromata!

Bone metastases were present in three of these cases, in addition to the case here recorded in detail. In one case the metastasis was in the frontal bone and humerus — Case II. In another case the metastasis was in the humerus — Case X. In the third case the metastasis was in the femur — Case IX.

Albrecht records four cases with bone metastases, besides the two cases already mentioned in which the bone metastases were the sole metastases. These four cases with bone metastases were briefly as follows:

(The numbering of these cases corresponds to Albrecht's series.)

IV. A woman sixty years old presented a spontaneous fracture of the *left femur*. An amputation was done in the upper third of the thigh for sarcoma of the femur. Recovery from operation; five and a half years later a kidney tumor, hypernephroma, was discovered; complete autopsy was done. The urine was always negative. (See Fig. 5.)

VII. A man forty-two years old presented *frontal* and *temporal bone* hypernephromata. An attempt was made to remove the growth. He died after operation. Autopsy discovered a hypernephroma. The urine contained albumin. (See Fig. 6.)

XV. An adult, forty-eight years old, presented what was thought to be a fungus disease of the *knee-joint*. The thigh was amputated. Death occurred. The tumor proved to be a hypernephroma metastasis. The urine contained some leucocytes and cells which might have been interpreted as tumor-cells.

XVI. A woman, sixty-six years old, presented what was thought to be a cold abscess over the *clavicle*, with a tubercular periosteitis. An attempt at removal was followed by recurrence and death. A complete autopsy discovered a hypernephroma and microscopical examination demonstrated the tumor of the clavicle to be a hypernephroma metastasis. The urine contained a few leucocytes. (See Figs. 7 and 8.)

There are seven other cases of bone metastases in literature, viz., Loewenhardt,[1] from Helferich's clinic, reports a *clavicle* metastasis resembling Hochenegg's Case XVI; von Bergmann's klinic[2] reports a pulsating *tibial* tumor; Israel[3] reports a case in which the metastases in the *rib* and *thigh* were the first signs of hypernephroma. Küster[4] reports two cases in which the metastasis was the first sign in one case in the *calvarium*, and in the other case in the *rib*. Le Count[5] reports one case with two fractures of the femur and one case with metastases in the superior maxilla.

So far as I have been able to determine there are, therefore, recorded of bone metastases, six cases from Hochenegg's clinic, seven cases from literature, and four cases from the Massachusetts General Hospital clinic, seventeen cases altogether. There are doubtless other cases, but none in which the records are complete or the authority satisfactory.

The practical suggestions from this review of the metastases of the hypernephroma are: A bone metastasis may be the first sign of a hypernephroma. A bone tumor in a middle-aged or elderly person should suggest a metastatic hypernephroma, for a primary bone tumor in elderly people is uncommon. The bone metastasis from a hypernephroma may be the only metastasis. A hypernephroma may exist without symptoms for a considerable period. The kidney region should be palpated with great care in every case of tumor of bone.

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[1] Deutsche Zeitschr. f. Chir., bd. 28, 1888.

[2] Verhandlungen des 16 Congressen der Deutschen Gesellschaft f. Chir., 1887.

[3] Archiv. f. klin. Chirurg., bd. 47.

[4] Deutsche Chirurg., 1896–1902.

[5] Trans. Path. Soc., Chicago, 1902, V, p. 82, and VI, 1905, p. 373.

A very complete bibliography is to be found at the end of the paper by Keen, Pfahler and Ellis in *American Medicine*, vol. viii, No. 25, Dec. 17, 1904.

Thorndike and Cunningham present a valuable paper upon hypernephroma in the *Boston Medical and Surgical Journal*, vol. cxlix, No. 23, pp. 611–616, Dec. 3, 1903.

MASSACHUSETTS GENERAL HOSPITAL CASES OF HYPERNEPHROMA.

Case I.—*Hypernephroma (left), hematuria lumbar pain nephrectomy. Recurrence in loin five years later. Death.* J. R. O., a man, forty-nine years old and married. M. G. H. records, vol. 338, p. 143, and vol. 512, p. 57, 1898. The patient has had indefinite pain in the back for a long time. Two months ago he had a painless hematuria, lasting four days. One week later he had hematuria again, this time with clots in the urine and severe pain in the left lumbar region requiring morphia. The left kidney was found enlarged and sensitive. Two weeks ago he again had pain in the left lumbar region, requiring morphia for two days.

The patient is well developed and nourished. The heart and lungs are negative. On bimanual palpation of the left lumbar region the kidney can be palpated with difficulty. There is a little tenderness over the left kidney. The x-ray shows a slight haziness upon the left side, but no calculus. Urinary examination: normal; acid, 1016; albumen, $\frac{1}{10}$ per cent. Sediment normal blood, much pus, free and in clumps, few squamous cells.

Operation by Dr. F. B. Harrington. Nephrectomy.

Pathological Report.—The specimen consisted of a kidney, and extending from one extremity downwards, filling up the hilus, is an irregularly-shaped mass the size of an orange, arising from the adrenal body. On section this showed numerous cysts, some of which contained blood, others a clear fluid. Numerous areas of fatty degenerated adrenal tissue appeared. The diagnosis of sarcoma was made at this time.

In 1905, almost six years following the nephrectomy, the patient complains of pain and persistent hematuria. Up to a year ago he felt pretty well. One year ago he had noticed a swelling at the site of the wound and pain across the back, which sometimes shoots down into left thigh. Both pain and swelling have increased very much this past year.

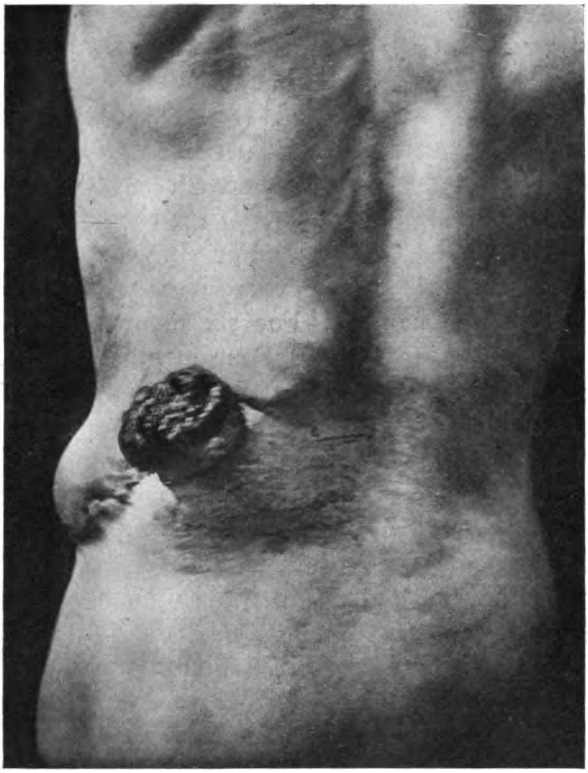

FIG. 9.—Case No. 1: Recurrent hypernephroma of loin.

The palpable and visible tumor is shown in the photograph (Fig. 9). A piece was removed for examination in the service of Dr. Scudder.

Pathological report of recurrence in loin June 6, 1905. Two pieces of tissue, the largest, 3x2 cm. in diameter, consisting of skin and subcutaneous tissue, in which was a nodule of grayish-white growth.

Microscopic examination by Dr. W. F. Whitney shows an alveolated structure, with spaces filled with large cells with a clear body and a relatively small, dark, deeply-staining nucleus.

Diagnosis.—Secondary hypernephroma. This patient was sent home to die from the hospital.

Case II.—*Hypernephroma (left). Many metastases. Excision of frontal bone tumor. Blindness. Death.* A woman, forty years old and married. M. G. H. records, vol. 429, p. 189, and vol. 435, p. 13, 1903. The patient has had no serious illnesses. For six years she has had headaches, which have been very severe for the past year. She has had no nausea. For six months she has had vague "mental symptoms." Four months ago there appeared a swelling over the left frontal eminence, the size of a small egg. The frontal tumor was removed yesterday by her doctor, who found an opening from it into and through the frontal bone. Great hemorrhage. Sent to the hospital.

The patient is a pale, thin, nervous woman. Reflexes present. Heart rapid, no murmurs, no enlargement. Lungs negative. Further operation is thought inadvisable, as the wound is healing. It is thought that the growth might have been specific in character. Given iodide of potash.

Examination of the urine; pale, acid, 1023, slightest possible trace of albumen, sugar absent; sediment, a rare granular cast, some small round cells, abundant squamous epithelial cells, many uric acid crystals.

A small, firm lump has recently appeared over the right eyebrow. It is not tender. She was discharged from the hospital without operation. One month later, in April, 1903, she reëntered the hospital.

At the seat of the old operation is a bluish, fluctuating tumor the size of an English walnut, slightly painful upon pressure. Over the right eye is a tumor, described above, slightly movable, about the size of a small marble. On the right parietal bone is a third similar tumor of smaller size. An indefinite mass can be felt in the left side of the abdomen under the costal border, which is slightly tender on pressure. The chest on the left side is dull to the eighth rib in the axillary line. The deltoid muscle of the left arm is considerably atrophied.. Upon the left shoulder, in the region of the great tuberosity of the humerus, is a hard, rounded tumor about the size of a small egg. The tumor is not painful upon pressure. There was no relief from x-ray treatment. All the tumors were increasing in size. The patient was anxious to have an operation.

The tumor over the right eye was removed by Dr. M. H. Richardson. The growth was found to have perforated the frontal bone.

The patient lost in strength, and about three weeks after the operation died, totally blind, April, 1903.

The left chest was flat to the fifth rib in the axillary line. There was a high temperature.

Report by Dr. J. H. Wright from the Clinico-Pathological Laboratory. — The specimen received for examination contains several small tumors, the largest about 7 mm. in diameter and situated in what seems to be subcutaneous connective tissue. The tumors consist of closely packed cells of atypical character, having vesicular nuclei and considerable cytoplasm. A good many small blood-channels permeate the tumors. Some of these appear to be lined with a delicate endothelium. The tumors are regarded as sarcomatous in character and not inconsistent with hypernephroma.

Case III. M. H., a woman forty-one, single. June 5, 1903, M. G. H. records, vol. 442, p. 203. The patient has been running down in general health for the past two years. She worked up to one year ago. Eight months ago she noticed a "lump" in the left side, which has grown steadily larger. No pain is felt in this "lump." For the past three weeks her belly-wall has been tense. She has lost much weight. There has been frequency of micturition during the past few months. She has had to sit erect at night in order to breath with ease.

Patient is a poorly developed and nourished person. A pre-systolic heart-murmur is heard, which is transmitted into the axilla. The chest is apparently normal. The abdominal walls are tense. The abdominal tumor is about the size of a twin pregnancy at term. The girth is 42½ inches. There is a fluctuation wave over the whole abdomen. All the pelvic structures are pushed down into the pelvis.

June 6, 1903. Operation. Nephrectomy by Dr. C. L. Scudder. Six to eight quarts of a free brownish fluid in the abdominal cavity. Colon displaced toward median line.

Death June 10, 1903, five days after the operation, due to weakness and shock.

Pathological report by Dr. W. F. Whitney. — A kidney, in which was a very large new growth, which weighed 2280 grams. On section it was very soft, medullary in character, and of a rather variegated surface, in which yellow and red extensively predominated. The kidney was about half destroyed and into the pelvis of the kidney projected masses of new growths, as well as into the lumen of the renal veins.

Microscopic examination June 6, 1903, showed a reticulated fibrous structure, among which were large cells with rather clear protoplasm and large nuclei and nucleoli.

Diagnosis. — Hypernephroma.

Case IV. M. M. R., forty-years old, a widow. June 21, 1904. M. G. H. records, vol. 46, p. 108. She has always had fair health. Last year, before Christmas, the patient first noticed a dull, constant pain in the region of the left kidney, sometimes shooting into both groins. The pain sometimes caused vomiting. Frequency of micturition at night and a very great variation in the amount of urine passed upon different days has been noticed by the patient ever since the beginning of the pain. She has lost weight for the past six months. The abdomen is not distended.

Below the floating ribs upon the left is an area of marked tenderness which corresponds to a tumor of the left kidney.

Operation. — Nephrectomy by Dr. W. M. Conant. A hard mass was felt in the lower end of the kidney. The renal vessels were controlled by pressure of the fingers, and the kidney cortex was split over the mass. This mass was found to consist of a rounded, firm tumor about the size of an ovary; it was easily shelled out. The rents in the pelvis and kidney were closed.

Dr. J. H. Wright reports that the diagnosis is hypernephroma. This patient died a few months after the operation.

Case V. L. C., a woman forty years old, married; July, 1904. M. G. H. records, vol. 480, p. 97. The family history is negative. The patient's history: cholecystotomy for gall-stones eight years ago. No catamenial period for one year. Three children living. Has lost about sixty pounds in weight during the past two years. She has pain in the lower part of the abdomen, a bearing-down sensation and no appetite. The bowels are regular and she sleeps fairly well. Nothing abnormal in heart or lungs. Abdomen prominent and tense from distention. An umbiblical incarcerated omental hernia size of a walnut is evident. Abdominal asymmetrically distended to left of median line, not tender. Exploratory laparotomy by Dr. C. L. Scudder. Much thickening of the anterior parietal peritoneum. Encysted peritonitis toward the pelvis. Upon the peritoneum of the intestine were numerous white opaque spots the size of a pin head, slightly raised above the surface. On the side of each ovary was a mass, two inches in diameter, papillomatous in appearance, hard and white. Small section of mass on left taken for examination. Nothing abnormal was felt in the liver. It seemed probable that the ovarian masses and the disseminated spots upon the peritoneum were malignant, therefore no further operation was deemed wise.

She died March 4, 1905.

Pathological Report. — Two small, irregular masses of tissue from the abdominal cavity. One was of irregular shape, 2x4 cm. in diameter, and consisted of soft, friable, translucent tissue. The other piece was firmer and of opaque, grayish-white color, 1x2 cm. in diameter.

Microscopic examination showed nests of cells having in some places a glandular arrangement and in other places being arranged in columns separated by a small amount of fibrous tissue. The cells were large, with rounded nuclei and considerable protoplasm which, in some, showed fatty degeneration. In some places the cells were in large masses and showed a smaller amount of protoplasm. These larger masses were separated by cellular myomatous tissue. Hypernephroma.

(Signed) W. F. Whitney, M.D.

Case VI. S. P. H., a woman fifty-eight years old, unmarried. M. G. H. records, vol. 479, p. 71. August, 1904. Family history negative. Patient's history: measles, chicken-pox, scarlet fever at three years, after which was somewhat deaf. Climacteric five years ago. Some indigestion; always constipated; drinks considerable tea Fifteen months ago weighed 198 pounds, now weighs 138 pounds and has lost fifteen pounds in the last six months. Six weeks ago had pain in the right side and noticed a bunch about the size of a hen's egg. "Felt bad," no appetite, nausea and slight vomiting. The lump has grown steadily. The heart has a systolic murmer, heard loudest at the base, not transmitted; the lungs are normal. The abdomen is large and flabby. On the right side, just opposite the level of the umbilicus, was a rounded tumor, with several lobes, about the size of a large grape fruit. It extends from the region of the right kidney to the anterior abdominal wall, with a space separating it from the liver and considerable space between it and the pelvis. It extends to the median line. On inflation of the colon the tumor lies to the right, towards the diaphragm. The tumor moves freely with respiration.

A nephrectomy by Dr. S. J. Mixter. Recovery. Confined to her bed with malignant disease of abdominal organs, dying Nov. 4, 1905.

Pathological Report.—The specimen consisted of a rounded growth from the kidney 14 cm. in diameter, from the surface of which considerable fat was removed. On section the growth consisted of a cavity 10 cm. in diameter, filled with thick, yellow pus. The cavity contained a flattened stone 1 cm. in diameter, and a rounded mass of tissue 3 cm. in diameter covered with fibrin. The rest of the mass was composed of a soft tumor of translucent, red, grayish color, 5x7 cm. in diameter. Scattered throughout this were many bright yellowish areas. The growth was divided into cross lobules by bands of fibrous tissue extending down from the capsule.

Microscopical examination showed soft masses of large endothelial-like cells often arranged in columns. Nuclei were round and vascular, and a large amount of cystoplasm, and most cells showed fatty degeneration. In places the tumor was very vascular and in others extensively necrotic, these latter areas being infiltrated with large numbers of leucocytes and round cells.

Diagnosis, hypernephroma.

(Signed) W. F. Whitney, M.D.

Case VII. J. H., a man, thirty-seven years old, single. M. G. H. records, vol. 490, p. 25. October, 1904. Last June he stopped work because of soreness and pain in the right loin upon moving at his work. This condition came on in a week and has persisted since. No blood detected in the urine. Three years ago he had typhoid fever. Heavily alcoholic up to four years ago. Nothing abnormal found in either heart or lungs. No rigidity of abdomen and no tenderness. In the right loin there is a soft mass. The kidney is palpated with ease. Bimanually, it can be slid up under the cartilage of the ribs, and can be displaced almost to the iliac fossa when the patient is lying on his side.

Operation by Dr. J. C. Warren. Nephrectomy. Died in August, 1905, of "liver complaint."

Pathological Report. — A lobulated new growth, 6 cm. in diameter, situated on section of kidney. On section, of a variegated yellow, red appearance, somewhat lobulated in structure and soft in quality. The large veins in the pelvis were filled with a similar new growth, as were also some veins in the lower part of the kidney. The rest of the kidney structure was normal in character.

Microscopical examination showed a structure composed of large cells with rather clear protoplasm, and its end edges separated into a rather lobular arrangement of thin glands of connective tissue and small thin-walled vessels. Hypernephroma.

(Signed) W. F. Whitney, M.D.

Case VIII. J. H., seventy-five years old. Nov. 1, 1904. Hospital number, 139,906. Autopsy, No. 1270. He has had a bad cough for years, and pains for six months in the left eye and frontal region. He has lost weight. He fell on the kitchen floor and fractured his thigh, and was then brought to the hospital. The patient is an emaciated old man, having arteriosclerosis. The left eye-ball is protuberant. A firm, hard, tender mass is attached to the roof of the left orbit. Many nodules are scattered over the body, the size of a chestnut to a large walnut. There is one ulcerating mass over the sternocleidomastoid muscle and one over the right scapula. The nodules are firm, moving in the skin, not tender or red. No tumor is felt in the abdomen. The urine is normal. The left femur is fractured at its middle. The usual Buck's extension was applied. The patient died two days later.

Autopsy by Dr. J. H. Wright, Nov. 5, 1904. Anatomical diagnosis: Hypernephroma of the right adrenal. Metastases in the retro-peritoneal tissue, intestines, liver, lungs, pleura, myocardium, brain, subcutaneous tissue in various regions, left orbit and *left femur*. Local pneumonia of the superior lobe of the right lung. Adenoma of the prostate. Chronic pleuritis of the right lung.

Case IX. E. F. H., a man thirty-three years old. M. G. H. records No. 135,648. January, 1904. For six years he has noticed a pimple upon the pinna of the right ear. This has gradually increased in size. Three years ago it had reached the size of the end of a thumb. It was cauterized. It recurred and grew rapidly. It has never been painful. It bleeds from the surface upon slight trauma. The urine is normal. The abdominal examination finds nothing abnormal. The right ear-lobe and cartilage are changed to a foul, sloughing, bleeding mass. There are enlarged glands in the neck upon the right side. Operation by Dr. F. B. Harrington. Removal of ear and dissection of the right side of the neck.

Pathological report by Dr. W. F. Whitney.—The microscopical examination of the mass removed showed a lobular growth of large round cells, with little intercellular substance between them here and there.

Diagnosis.—Large round-celled sarcoma (hypernephroma).

May, 1904, the man entered the service of Dr. M. H. Richardson. The urine showed sp. grav. 1025; a very slight trace of albumen; no sugar; rarely a cast, a few squamous and round cells; a few red blood corpuscles. The wounds of ear and neck had healed. The man had lost thirty pounds in three weeks past. He complained of great pain in the shoulder and because of it was unable to sleep. He died June 22, 1904.

A complete autopsy by Dr. J. H. Wright. Hypernephromata of the adrenals. Metastases in the intestines, stomach, great omentum, mesocolon, retro-peritoneal tissue, pancreas, peritoneum, right groin, right shoulder joint (*upper end of the right humerus*), subcutaneous tissues of the trunk and brain.

Case X. W. W., sixty-five years old, married. Mass. Gen. Hospital, No. 143,207. June 28, 1905. Patient has always been well. During the past four months he has lost forty-five pounds in weight. A few weeks ago he noticed a swelling in the left scrotum. Has had dyspepsia for several years, of a mild type. Has been getting more and more constipated. Has never passed blood in the stools. He presents a cachexia. The abdomen is moderately distended. The left hypochondrium is occupied by a bulging tumor, which is elastic, smooth, semi-fluctuating, about the size of a football. The liver is palpable just below the right costal margin. There is a large varicocele in the left scrotum. The colon overlies the tumor.

An operation was done for the removal of a portion of the abdominal tumor for diagnosis, July 1, by Dr. J. G. Mumford. Patient died July 12, 1905. There was no autopsy.

The pathological report by Dr. C. C. Simmons of the bit of tissue removed from the abdominal tumor is as follows:

The specimen consisted of an irregular dark-colored mass of fibrous tissue 10x12 cm. in diameter. On section portions of the mass were of a grayish translucent color, while other places were necrotic or hæmorrhagic. Microscopical examination showed solid masses of large cells arranged roughly in columns and having sharply marked outlines and clear protoplasm. The nuclei were large and many of them vesicular. There were large numbers of mitotic figures. In places there were spindle-shaped cells, many of which were also undergoing mitosis. Hypernephroma.

THE EXAMINATION AND SURGERY OF THE UPPER END OF THE ESOPHAGUS.*[1]

By Harris Peyton Mosher, M.D., *of Boston.*

Owing to the nature and position of the esophagus, its surgery is limited. In many conditions all treatment is simply palliative. The distress caused by interference with the functions of the esophagus, however, is so great that palliative measures are worth while and we should welcome any increase in their efficiency. Until recently the diagnosis of diseases of the esophagus has been made from the patient's history and the general symptoms, supplemented by the findings obtained from passing bougies. The treatment has been along restricted lines, and consisted of the use of bougies, with an occasional operation through the front or the side of the neck on the only accessible part of the esophagus, the upper half. Since the introduction of light-bearing tubes the diagnosis of diseases of the esophagus is no longer made by inference, but by sight and the removal of suspected tissue for the microscope.

This paper will take up briefly certain necessary points in the applied anatomy of the esophagus, will tabulate and review the cases of diseases of the esophagus treated as house patients in the Massachusetts General Hospital for the past nineteen years, will discuss the surgery of the upper end of the esophagus and will present a speculum and a set of instruments for examining the upper end of the esophagus and the larynx, and for working in this locality.

APPLIED ANATOMY.

Congenital Anomalies.—The esophagus may be divided or double. It may open into the trachea; the lower part being absent. Fistulas between the trachea and the esophagus occur and annular strictures which are congenital are found. True diverticula are acquired. In the upper part of the esophagus they are due to a hernia of the esophagus through the inferior constrictor muscle. They may be due also to the contraction of scar tissue which joins the esophagus to neighboring structures.

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* Read in the Section on Laryngology and Otology of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906. Reprinted from The Journal of the American Medical Association, Nov. 24, 1906. vol. xlvii, pp. 1695–1701.

[1] Models made in the Anatomical Laboratory of the Harvard Medical School.

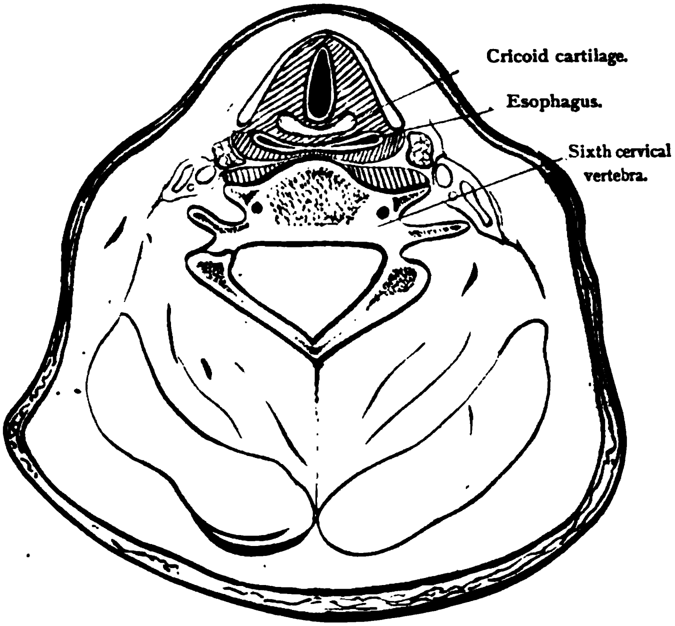

FIG. 1.—Cross-section of the neck through the sixth cervical vertebra.

Structure.—The esophagus has an outer muscular coat of two layers and an inner grandular coat covered with pavement epithelium. A connective tissue layer joins the two chief layers. The outer layer of the muscular part consists of longitudinal fibers and the inner layer of circular ones. The anterior longitudinal fibers are attached to the back of the cricoid cartilage. The inner layer of circular muscular fibers is a continuation downward of the fibers of the inferior constrictor muscle. The upper end of the esophagus is the lower end of the pharynx, so that

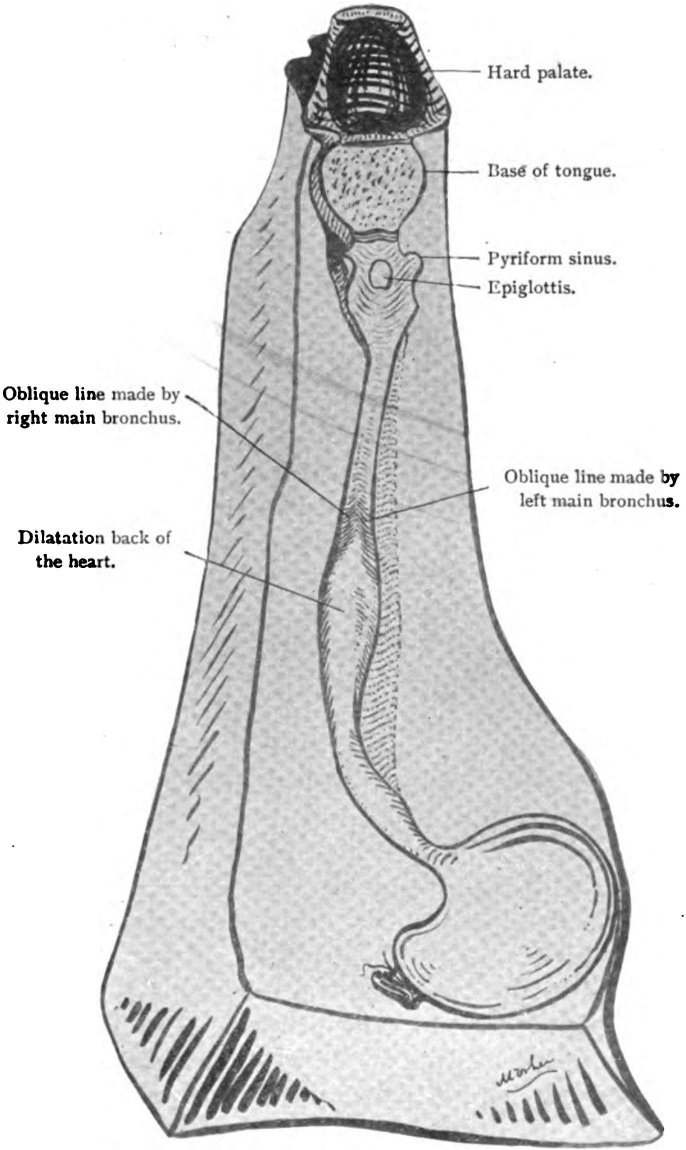
Hard palate.
Base of tongue.
Pyriform sinus.
Epiglottis.
Oblique line made by right main bronchus.
Oblique line made by left main bronchus.
Dilatation back of the heart.

Fig. 2.—Wax cast of the esophagus.

voluntary muscular fibers predominate in it. From this it happens that a foreign body arrested at the entrance of the esophagus often is thrown back into the pharynx and into the mouth.

Lymphatics. — The lymphatics of the pharynx enter both the mediastinal and the cervical glands so that in suspected cancer of the esophagus the glands at the root of the neck should be examined.

Direction. — The esophagus is placed in the greater part of its course a little to the left of the middle line. In the middle of its course, at the fourth thoracic vertebra, it swings to the middle line, back of the arch of the aorta, but at once turns to the left again and enters the stomach to the left and in front of the aorta, at the eleventh thoracic vertebra. This deviation from the middle line does not interfere with the passing of bougies or tubes except at the lower part where the esophagus passes through the diaphragm. Here the point of a metal tube has to be swung to the left if its passage is to be painless.

Position. — The esophagus has the vertebral column behind it and the trachea in front and lying on it. At the fourth thoracic vertebra the arch of the aorta makes a transverse constriction in it and a vertebra lower down the left main bronchus, at the fifth thoracic, makes an oblique line across its front surface. Below this point the heart lies on it like a weight. In the lower part, the right and left pneumogastric nerves lie on the sides of the esophagus, and back of the arch of the aorta the thoracic duct crosses from right to left behind it, on the front of the vertebral column.

Lumen. — At the beginning the esophagus is a transverse slit slightly less than an inch wide (Fig. 1). The width increases somewhat on the way down, and the esophagus becomes more of a tube until at the point where it goes through the diaphragm it is nearly round and measures a little over an inch in both diameters (Fig. 2). The most important constriction of the esophagus is at the beginning, back of the cricoid cartilage. The narrowing next in importance is at the cardiac end. The constrictions back of the arch of the aorta and behind the left main bronchus are less important. The upper narrowing

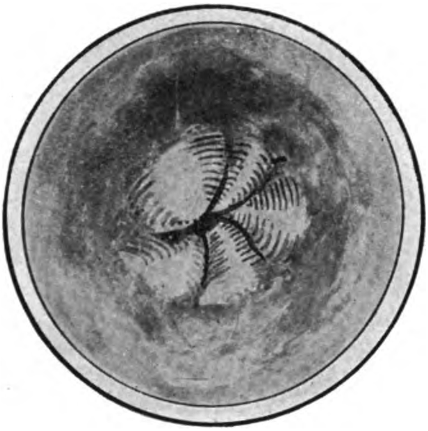

FIG. 3.— Normal esophagus, quiet breathing.

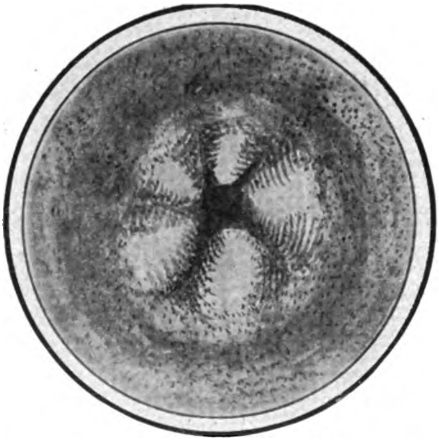

FIG. 4.— Normal esophagus, deep breathing.

PICTURES OF THE ESOPHAGUS OBTAINED THROUGH THE ESOPHAGEAL TUBE.

is due to the cricoid (Fig. 1). The lower constriction is caused by the fibers of the diaphragm as they surround it (Fig. 2). One of the two wax casts of the esophagus which I made shows these measurements nicely (Fig. 2).

In the other the constriction at the diaphragm is much narrower than one inch. Both casts show a marked dilatation of the esophagus back of the heart. This is limited above by two oblique lines, a right and a left, made by the right and left main bronchus. The V made by the bifurcation stamps itself on the esophagus. In both casts this dilatation lay markedly to the right of the median

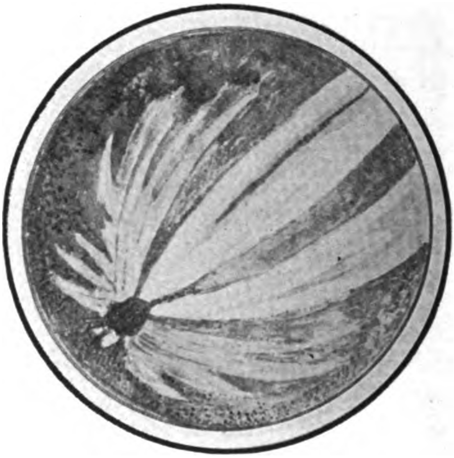

FIG. 5. — Scars from acid burns radiating from the lumen of a stricture.

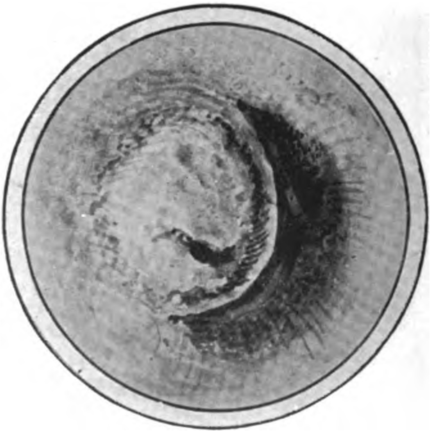

FIG. 6. — Carcinoma.

PICTURES OF THE ESOPHAGUS OBTAINED THROUGH THE ESOPHAGEAL TUBE.

line. The esophagus begins 6 inches from the incisor teeth, back of the cricoid cartilage at the sixth cervical vertebra. It is 10 inches long, and goes through the diaphragm at the tenth thoracic vertebra, 16 inches from the teeth. It is crossed by the arch of the aorta back of the middle of the first piece of the sternum, 10 inches from

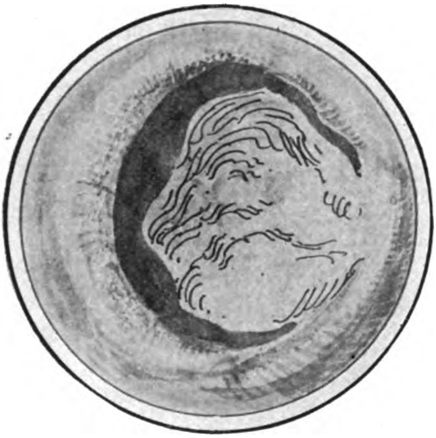

FIG. 7. — **Carcinoma.**

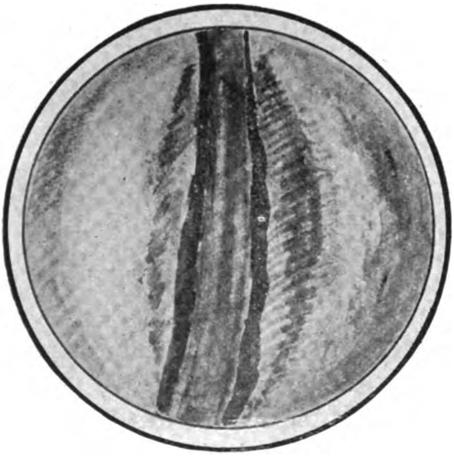

FIG. 8. — **Fishbone.**

PICTURES OF THE ESOPHAGUS OBTAINED THROUGH THE ESOPHAGEAL TUBE.

the teeth. The measurements to be remembered in connection with it are, then, 6 and 10.

Distensibility — A ½-inch bougie should pass easily everywhere. Its failure to pass is a sign of stricture. A ¾-inch bougie is the largest which should be used to dilate the esophagus. The distensibility of the esophagus is much greater in the living than in the dead. On the dead, when the esophagus is stretched transversely only, it dilates to 40 mm., or 1½ inches. The ordinary full-sized tooth plate is 2¼ inches (57 mm.) broad. A 50-cent piece is 1⅛ inches (30 mm.) wide. Since the transverse diameter of the esophagus hovers around 1 inch it would seem as if this coin should pass readily in an adult. The direction in which the esophagus will stretch the most is from side to side. For this reason oval tubes take up the slack in the esophagus along anatomical lines

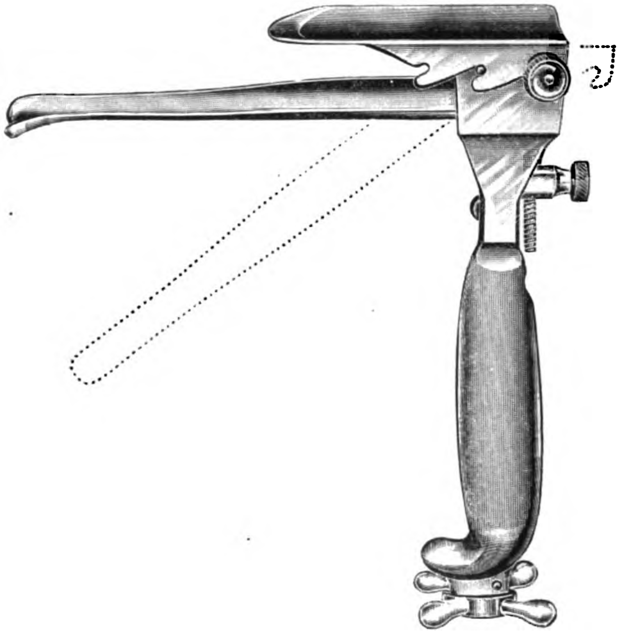

FIG. 9. — Author's speculum.

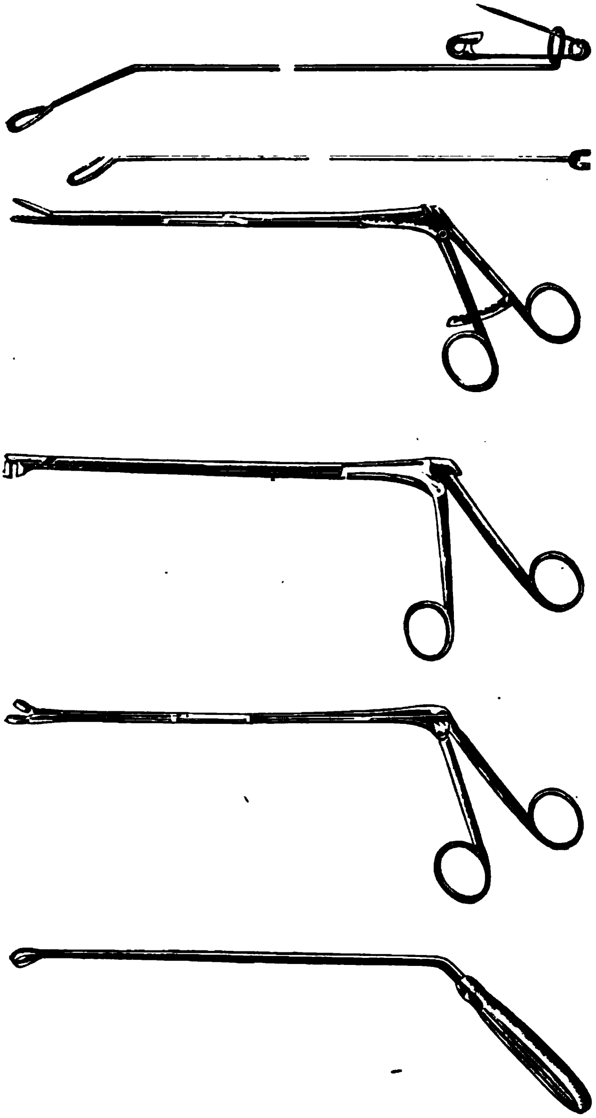

FIG. 10.—Instruments used by author.

(The first two instruments are for closing and removing a safety pin.)

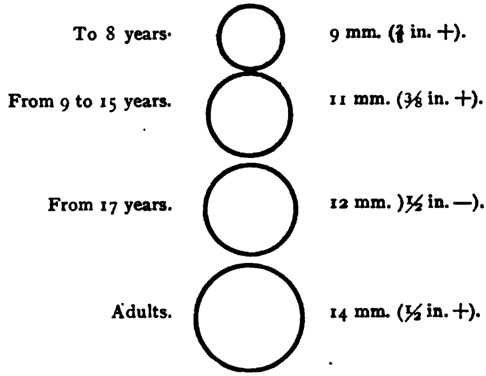

FIG. 11.—Diameters of esophageal tubes for different ages.

DIAMETERS OF THE ESOPHAGUS AT THE FOUR CONSTRICTIONS.

Constriction.	Diameter.	Vertebra.
Cricoid	Transverse 23 mm. (1 in.) Antero-posterior 17 mm. (¾ in.)	Sixth cerv.
Aortic	Transverse 24 mm. (1 in.) Antero-posterior 19 mm. (¾ in.)	Fourth thor.
Left bronchus	Transverse 23 mm. (1 in.) Antero-posterior 17 mm. (¾ in.)	Fifth thor.
Diaphragm	Transverse 23 mm. (1 in. +) Antero-posterior 23 mm. (1 in. —)	Tenth thor.

LENGTH OF THE ESOPHAGUS AT DIFFERENT AGES.

	Teeth to Cricoid.	To Bifurcation.	To Cardia.	Length of Whole Esophagus.
Birth,	7 cm. (2¾ in.)	12 cm. (4¾ in.)	18 cm. (6¾ in.)	10 cm. (4 in.)
1 year,	10 cm. (4 in.)	14 cm. (5½ in.)	22 cm. (8¾ in.)	12 cm. (4¾ in.)
2 years,	10 cm. (4 in.)	15 cm. (6 in.)	23 cm. (9 in.)	13 cm. (5⅛ in.)
5 years,	10 cm. (4 in.)	17 cm. (6¾ in.)	26 cm. (10¼ in.)	16 cm. (6⅜ in.)
10 years,	10 cm. (4 in.)	18 cm. (7 in.)	28 cm. (11 in.)	18 cm. (7 in.)
15 years,	14 cm. (5½ in.)	23 cm. (9 in.)	33 cm. (13 in.)	19 cm. (7½ in.)
Adult,	15 cm. (6 in.)	26 cm. (10¼ in.)	40 cm. (15¾ in.)	25 cm. (10 in.)

better than round ones. The preceding tables are compiled from Stark. They are of use for reference.

For memorizing the length of the esophagus at different ages the following approximate figures are given: Birth, 7 inches; 5 years, 10 inches; 15 years, 13 inches; 25 years, or adult, 16 inches (Stark).

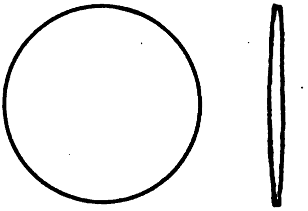
FIG. 12. — Shell button, actual size, swallowed and passed by a child one year old. Case of Dr. E. A. Codman.

CLASSIFICATION OF DISEASES OF THE ESOPHAGUS.

I have tabulated the cases of diseases of the esophagus which have been treated in house patients for the past 19 years at the Massachusetts General Hospital. An attempt was made to get the end results of cases for the past 10 years. Out-patient cases were not investigated, because the information which could be obtained was too fragmentary. In the list thus compiled there is one case of abscess of the esophagus and there are three of diverticulæ. Stricture gave the greatest number of cases. Of these there are 106.

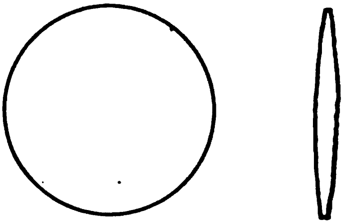
FIG. 13. — Shell button, actual size, swallowed and passed by a child nine years old.

Stricture.—Of the 106 cases of stricture the nature of

88 was not determined. The answers to the letters of inquiry show that very many of these were cases of cancer. There are 16 strictures due to swallowing some corrosive fluid. Such cases, therefore, make about 16 per cent. of all. One stricture was classed as syphilitic and one as congenital. In the future, with our more exact methods of examining the esophagus, time will not be relied on so often to settle the diagnosis.

Carcinoma.—Thirty-six cases are entered as carcinoma, or about two a year. The reports from these cases are tragic in the extreme. They show that the surgery of carcinoma of the esophagus is simply palliative.

Foreign bodies in the esophagus.—In marked contrast to the cases of carcinoma of the esophagus the cases of foreign bodies in the esophagus often have an element of comedy. There are 57 cases of foreign bodies in the esophagus. They are divided as follows:

Coins	14
False teeth	12
Round whistles	6
Bits of bone	4
Common pins	3
Buckles	3
Safety pins	2
Stones	2
Peach stone	1
Button	1
Collar button	1
Spoon	1
Suspenders (a pair)	1
Objects not named	6
	57

From this list it is evident that the two most common foreign bodies are coins and false teeth. Next comes the round penny whistle. Babies crawling on the floor pick up coins and bits of bone and stone. They must also pick up pins and buttons, but these, as a rule, go on and out without causing trouble. Buttons give trouble more often in the nose and pins in the trachea. The case, therefore, might be stated as follows: the toothless baby swallows coins and whistles; the toothless man swallows his false teeth. The majority of foreign bodies cases occur in infants or children. After 5 or 6 years of age the esophagus is of sufficient size and distensibility to take care of smooth objects with great ease. I know of one child where all small coin passes readily. When she was 8, a half-dollar was swallowed and passed. She is now 9, but silver dollars are kept away from her for prudential reasons. The great distensibility of the adult esophagus is shown by the sword swallowing of the juggler. Once entered in the esophagus, a foreign body has to be of very considerable size and rough in order to keep from going down. False teeth are the commonest foreign body to meet these requirements. In one of the cases tabulated opposite the teeth were never found, but the end of the probang broke off in the attempt to find them and was passed a few days after. In another case the plate was passed in a few months after the patient left the hospital. In the light of these two cases, the man who left the hospital untreated and against advice, preferring to trust nature rather than the surgeon, was not so foolish as it would seem. Among the demented the beginning of the intestinal canal, the same as the end, is the receptacle of queer articles. The list includes two cases of this kind. In the first a spoon was swallowed; in the second a part of a ball of string, three buckles and a pair of suspenders. The following man could not be classed as demented, but he surely was most unfortunate. He went to a party and ate some candy. The candy stuck to his false teeth. He swallowed the candy and his teeth, too.

Treatment.—In surgery 20 years is a long time. One would expect in this period, therefore, many changes. In the surgery of the esophagus, however, there have been but few. The greatest change as well as the greatest advance is the safe laparotomy of to-day, which allows the stomach to be opened in order to reach foreign bodies lodged in the thoracic part of the esophagus, or to establish a permanent gastric fistula as the last resort of palliative treatment. In most of the coin and whistle cases the records show that the bristle probang and coin catcher failed to remove the foreign body, so that most of these cases were treated by opening the esophagus from the side. The great majority of the patients recovered without incident and had no subsequent trouble. Pneumonia followed the operation but rarely. This method must be regarded as heroic, perhaps, but satisfactory. With our light-bearing tubes of to-day, I feel that the majority of such cases should be managed without the external operation. Smooth foreign bodies predominate with children, but with adults rough ones are commonest. The sharp angles of tooth plates imbed themselves so firmly in the esophagus that prolonged attempts at extraction with tubes often make matters worse. The esophagus is a septic tract, so that it is not advisable to connect it with the tissues of the neck or with the pleural cavity.

From a review of the cases, the treatment of strictures of the esophagus due to swallowing corrosive fluids seems to be fairly satisfactory. The majority of such cases need to have bougies passed at intervals for life. The severest cases are made livable by cutting the stricture with fish line. Some of these desperate cases require the repetition of this procedure a number of times and then, when as much has been gained as is possible, this gain is maintained by bougies. It would seem as if, with light-bearing tubes which allow us to come down on the stricture and examine it, that some method of cutting and dilating the stricture based on the methods used in the urethra ought to be devised for the esophagus. Speaking of the use of string in cutting strictures of the esophagus brings up another use of string in the esophagus which we who are using tubes might take advantage of more than we do. I refer to the procedure of having the patient swallow a string until one end is well entered in the upper part of the intestines. The free end comes out of the patient's mouth and is worn over the ear. When the lower end is well down in the alimentary canal, the upper end can be pulled on with considerable force without coming up. Such a taut string can be used for a perforated olive tipped bougie to run on. It is a sure guide, of course, to the lumen of the stricture. A similar string could be employed equally well to guide an esophageal tube to the opening of a stricture. As far as I know it is a matter of theoretical interest only to remember that a string fed to a patient in this way has been known to appear at the anus.

As the esophagus is covered with flat pavement epithelium, most of its malignant growths are epitheliomata. It has a liberal supply of glands, so that a new growth can start also from these. When the growth deeply infiltrates, palliative treatment is all that is possible, no matter whether the growth is in the upper or the lower portion of the esophagus. In the rare cases in which the growth occurs in the upper part of the esophagus and does not infiltrate, there is a chance of successful removal. One very pretty case of this kind went out of the hospital some months ago. Examination under ether by esophageal tubes showed a hard annular stricture just back of the cricoid. A small projecting knob was removed from this, which proved the growth to be carcinoma. The case was transferred surgical and the growth was removed through the neck by the left lateral route. It did not infiltrate and so was dissected out readily. The end of the divided esophagus was brought to the surface of the side of the neck and stitched there. The patient was fed through this by funnel and tube. The patient chewed her food and spit it into the funnel. In this case the esophageal tube located the place of stricture and determined its character. This was well worth while. Perhaps, by means of the tubes, we can soon determine what cases are operable and what are not. Figs. 3, 4, 5, 6, 7, 8 are pictures of the esophagus as seen through the esophageal tube (after Stark).

From the surgical standpoint, the most satisfactory esophageal cases are cases of diverticula of moderate size. A thorough dissection cures the case at once. Two such cases are in the house records.

SURGERY OF UPPER END OF ESOPHAGUS.

I have indicated to a certain extent the character of the surgery which is possible at the upper end of the esophagus. The upper end of the esophagus is the most accessible. This is fortunate, because the majority of pathological conditions are found here. The cricöid cartilage acts as a cartilaginous stopper and makes the beginning of the esophagus the narrowest part. Foreign bodies lodge first back of the cricoid; corrosive fluids are delayed longest at this point, so that strictures are commonest and most extensive here; congenital clefts choose this locality from embryologic reasons; diverticula are commonest here, and, finally, cancer is located, as a rule, at the upper or the lower end of the esophagus, seldom in the middle. All this is especially fortunate, because, even if palliative measures are all that are left in so many cases, they are vitally important for the comfort of the patients, since starvation is not an easy form of death.

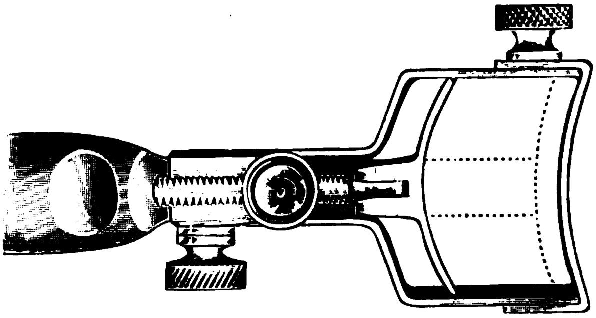

FIG. 14. — Method of regulating the width of the hood of the speculum.

The two methods of reaching the upper end of the esophagus by external operation are subhyoid pharyngotomy and lateral esophagotomy. Subhyoid pharyngotomy has a very evil reputation so many patients die in a few days of pneumonia. If the patient is operated on in the sloping position and kept in this position or the upright position afterward and not allowed to lie flat in bed, and, further, is fed by rectum for the first few days, the danger of pneumonia from secretions getting into the trachea is much lessened. The foreign body cases show that lateral esophagotomy is much safer than subhyoid pharyngotomy. When lateral esophagotomy is done for carcinoma, feeding by mouth is shut off forever, because the upper end of the esophagus is usually brought to the side of the neck.

Subhyoid pharyngotomy is a tempting operation for growths at the beginning of the esophagus; it is so direct. In a recent case in which I operated by this route for cancer back of the cricoid, the patient escaped immediate pneumonia from the operation, but did not regain the ability to swallow, so that after feeding by rectum for the first few days food was given partly by rectum and partly by the stomach tube. At the beginning of the third week the patient died of pneumonia. Lateral esophagotomy would have simplified the feeding in this case and possibly would have prevented the pneumonia.

Much can be done in the examination of the esophagus under cocain, but for exact examination, for the rapid dilatation of a stricture or for curetting a carcinomatous growth either for the purpose of diagnosis or for enlarging its lumen, ether is preferable. The cricoid cartilage is the great obstacle to the free passage of instruments into the esophagus. The constrictor muscles draw it back against the cervical vertebræ so that the opening of the esophagus becomes a transverse slit. If the head is bent back too far, the soft tissues are put so much on the stretch that the cricoid can be moved forward but little. On raising the head somewhat, however, the tension on the cricoid is released. It is important to remember this, especially in introducing esophageal tubes under cocain. The sides of the upper part of the esophagus do not have the rigid boundaries of the central part. The natural pathway for food into the esophagus is at the sides by way of the pyriform sinuses. Often it is easier to engage a bougie or a tube in the esophagus by placing it first in the pyriform sinus and not to bring it to the middle line until the cricoid has been passed (Fig. 2).

Figure 9 represents a speculum which I designed for the examination of the lower pharynx and the upper end of the esophagus and the pyriform sinuses. It enlarges the scope of the palliative measures which are possible in this locality. With the speculum there is a set of instruments of the proper length and shape for carrying out such procedures (Fig. 10). The speculum is Kirstein's tongue spatula developed into a bivalve speculum. In place of three hoods, the instrument has a single adjustable hood. Both the width and length of this can be regulated (Fig. 14). The long arm of the speculum is of sufficient length to pass by the epiglottis and to reach the middle of the back of the cricoid cartilage. This arm can be elevated so that the cricoid cartilage is pushed forward and the upper inch of the esophagus exposed. This instrument is of use also for examining and operating on the larynx by the direct method. It will always give a view of the arytenoids and the posterior half of the cords. In the majority of the cases in which it has been tried it has given a view of the anterior commissure. In trying to get a view of the anterior ends of the vocal cords I have found that it is better to work through a moderate opening of the hood. With a large opening of the hood the larynx is pushed forward and the tissues of the neck are so stretched that the esophagus balloons widely, but the front of the larynx is pushed out of the line of vision.

The advantage of examining and working on the lower part of the pharynx and the upper end of the esophagus through a speculum of this kind rather than to work through an esophageal tube is that you have the whole field in view at once. With the tube you work through a keyhole; with the speculum, through a window.

THE CAUSE OF SO-CALLED HABITUAL LATERAL CURVATURE OF THE SPINE.*

By Max Böhm, M.D.

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A partial statement of a theory concerning the origin of juvenile lateral deformities of the spine has been published by me in this journal[1] which differs considerably from the present conception of the cause of these affections.

During the past half year the theory has been placed upon a firmer basis by the accumulation of a greater number of additional observations upon patients and by further anatomical studies.

The following paper gives briefly *the most important points* of the theory, leaving its thorough description to a more extensive publication in monograph form which will appear soon.

ANATOMICAL PART.

(From the Anatomical Department of the Harvard University Medical School.)

The human spine consists normally of 33 to 34 vertebræ. It is divided into regions in a typical way: 7 cervical, 12 dorsal, 5 lumbar, 5 sacral, and 4 to 5 coccygeal vertebræ. (See diagram 1.)

Deviations from these normal numerical divisions of the vertebræ may occur in two ways; diagrams 2 and 3 show the character of this so-called "Numerical Variation."

Diagram 2 represents a variation in a cranial direction; that is to say, all the regional boundaries of the spine are placed higher than normally; the cervico-dorsal boundary is between the sixth and seventh, the lumbo-dorsal boundary between the eighteenth and nineteenth, the lumbo-sacral boundary between the twenty-third and twenty-fourth, the sacro-coccygeal boundary finally between the twenty-eighth and twenty-ninth vertebræ; the thorax has moved upwards, as have likewise the pelvic girdle and lower extremities.

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*Read before The Johns Hopkins Medical Society in Baltimore, Nov. 5, 1906. Reprinted from the Boston Medical and Surgical Journal, Vol. clv, No. 21, pp. 598-611, Nov. 22, 1906.

[1] A Contribution to the Etiology of Lateral Curvature of the Spine. Boston Medical and Surgical Journal, vol. cliv, No. 4, 1906.

Recent Researches on the Pathology and Etiology of Juvenile Spinal Deformities. Clinical Meeting of the Massachusetts General Hospital, Boston Medical and Surgical Journal, vol. cliv, No. 22, 1906.

Diagram 3 shows just the opposite conditions: the boundaries are placed lower than normally, the thorax and sacrum have moved downwards; the whole represents a VARIATION IN A CAUDAL DIRECTION.

The short oblique lines on each side of the axial line in the diagrams represent the intervertebral joints. From the eighth to the nineteenth vertebræ these joints show the familiar DORSAL TYPE having articular surfaces lying frontally, whereas from the nineteenth to twenty-fourth vertebræ the joints possess the LUMBAR CHARACTER, *i. e.*, they have surfaces, facing sagittally. Between the twenty-fourth and twenty-fifth vertebræ there is a joint of LUMBO-SACRAL type, *i. e.*, its articular surfaces run diagonally. Between the nineteenth and twentieth vertebræ there is normally a very sudden" ARTICULAR CHANGE," that is, the change from the dorsal to the lumbar joint type. (Diagram 1.)

In a cranial variation of the spine this change takes place one vertebra higher (diagram 2); in a caudal variation one vertebra lower than normally. (Diagram 3.)

Diagrams 2 and 3 are schematic and represent extreme degrees of variation which practically never occur. They indicate, however, the character and tendencies of lesser degrees of variation.

These LESSER DEGREES OF VARIATION lead to the production of those peculiar forms of vertebræ at the regional boundaries, called by the anatomist "TRANSITIONAL VERTEBRÆ" (Uebergangswirbel) which have in part some of the features of one region and in part some of the features of the neighboring region. Such are:

1. Occipito-cervical vertebræ. These are, for instance, represented by fusions of the atlas with the occipital bone.

2. Cervico-dorsal vertebræ. These are anomalous conditions of the seventh or eighth vertebra, in which the seventh has a rib ("cervical rib") or the eighth is associated with an underdeveloped or rudimentary rib.

3. Lumbo-dorsal vertebræ. These are anomalous conditions of the nineteenth or twentieth vertebra, in which the former loses its ribs or the latter is associated with "lumbar" ribs.

4. Lumbo-sacral vertebræ. These are anomalous conditions of the twenty-fourth or twenty-fifth vertebra, in which the former is associated with sacral wings or the latter loses them.

5. Sacro-coccygeal vertebræ. These are anomalous conditions of the twenty-ninth or thirtieth vertebra, where the former loses its lateral masses or the latter is associated with them.

The diagrams differ, furthermore, from nature in that as a rule the spinal regions do not vary in such a regular way as the schematic pictures show, but frequently *one* region shows a greater degree of variation than the others.

Finally both sides of the spine (left and right) frequently vary independently and *asymmetrically*. The latter fact, which interests us especially, is illustrated by diagrams 4, 5 and 6. Diagram 4 shows an *asymmetrical variation* in the lumbo-sacral region; the sacrum begins on the left side with the twenty-fourth vertebra, whereas on the right side with the twenty-fifth vertebra.

In diagram 5 we see the corresponding asymmetrical variation in the dorsal part. The left side of the thorax reaches from the seventh to the eighteenth segment, while the right extends from the eighth to the nineteenth vertebra.

Diagram 6 illustrates an instance of an asymmetrical variation of the "articular change." The articular change in this case takes place between the eighteenth and nineteenth vertebræ on the left and between the nineteenth and twentieth vertebræ on the right.

A beautiful illustration of these conditions is seen in Fig. 11.

Diagrams 4 to 6 are also schematic and represent conditions which hardly occur as pure as this in nature. For in nature the asymmetry is never as marked as in the diagrams; but usually both sides of the spine vary and an asymmetry exists only in the sense that one side varies more markedly than the other.

The numerical variation of the spine offers so many interesting points that in all countries embryologists, anatomists and anthropologists have devoted a great deal of study to it.

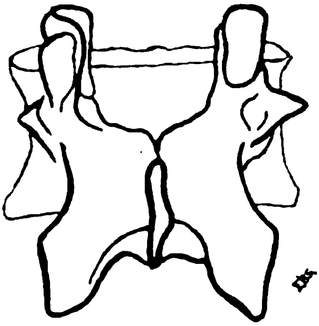

Fig. 11. — Asymmetrical lumbo-dorsal articular change.

Fig. 11 is taken from E. B. Smith. Two Rare Vertebral Anomalies, Jour. of Anat. and Phys., Vol. 36, 1902, p. 372.

We owe to embryological researches (Rosenberg, Bardeen) the knowledge that variations of the *caudal part* of the spine may be the expression of a deep developmental disorder, namely, of a faulty attachment of the total lower extremity (pelvis and free extremity) to the trunk, *i. e.*, the spine. An attachment of the pelvis higher than normal results in a shortening, lower than normal in a lengthening of the pre-sacral spine.

As to the origin of the numerical variation of the *cranial* part of the spine, nothing definite is known, just as the genesis of the typical differentiation at this part of the spine is obscure.

Some anatomists explain the numerical variation in a very interesting way, connecting it with the phylogenetic development of the human race. The father of this theory, the anatomist, Emil Rosenberg, considers the normal differentiation of the spine as typical for the present phylogenetic state of mankind, whereas a variation in caudal direction means a lower state, an atavism, and a variation in cranial direction signifies a step into the future, an epigonism.

The present paper shows how great a *clinical* importance this variation may have as an etiological factor in spinal deformities.

HOW CAN THE NUMERICAL VARIATIONS OF THE SPINE LEAD TO LATERAL DEFORMITIES?

1. Suppose a child is born with a spine like that shown in diagram 4. Free extremity (*a*), ileum (*i*) and sacral wings are attached to the spine, one vertebra higher on the left than on the right. Thus the pedestal of the free (pre-sacral) spine is, so to speak, asymmetrical. As soon as the child starts in to walk, these asymmetrical conditions will deform the vertebral bodies of the sacrum, and chiefly of the first sacral vertabra. Thus the foundation of the free spine becomes oblique and the latter will have to perform its functions in an abnormal position; the tendency of the body to compensate is added and thus we finally find in a certain period of life a deformed spine as the expression of a development which has been since the start on a wrong track. In this case (diagram 4) the *primary curve.* would be located in the LUMBO-SACRAL REGION; the convexity of the lumbar curve would be on the left side.

2. Diagram 5 shows conditions in which on one and the same vertebra ribs of different character are attached. For instance, on the eighth vertebra, which is normally the first thoracic, we find on the left side the second, on the right side, the first rib inserted. A comparison of normal first and second ribs shows a marked difference between the two. The first is short, strong and little curved, the

second is long, nearly twice as long as the first, slender and much curved. Thus we have in our diagram 5, corresponding to the eighth vertebra, a thoracic ring which is formed in front by the sternum, behind by the spine, and whose sides, the ribs, are markedly asymmetrical.

This asymmetry, only slightly developed in the embryo, increases in later life (see page 154) and causes, in connection with the tendency of the body to restore the balance, lateral deviation of the spine, which is the most movable part in the above-mentioned thoracic ring. In this case (diagram 5) the *primary curve* would involve the *cervico-dorsal region* and its convexity would be on the right.

3. From anatomical studies it is not quite certain whether a variation of the "ARTICULAR CHANGE" as shown in Fig. 6 may lead to lateral deformities. I believe that it may cause lateral deformities of slight degree, but it does not produce those with structural change in the vertebral bodies. However, the variation of the "articular change" may lead in another way to lateral deformities, namely, in a way as illustrated in diagram 7. We have here on the right between the eighteenth and nineteenth vertebræ an intervertebral joint of typical lumbar character, the "articular change" thus being one vertebra too high. Whereas on the left side the inferior articular process of the eighteenth vertebra is still dorsal; but the corresponding superior articular process of the nineteenth vertebra is lumbar. Thus there is on the left side between the eighteenth and nineteenth vertebræ on account of a lacking conformity of the articular processes *no* good joint formation at all. The superior process of the nineteenth does not support the inferior process of the eighteenth vertebra sufficiently, and the spine above the former will fall over to the left side.

This, and similar disturbances in the formation of the joints which undergo the "articular change," lead to more or less sharp-angled lateral deformities in the LUMBO-DORSAL REGION with the apex in the abnormal joint. In diagram 7 the lateral deformity would be very sharp-angled ("*lumbo-dorsale Abnickung*") and the angle would open to the left side; the convexity would be on the right side.

4. Combinations of the three mentioned causes of lateral deformities may lead to combined deformities.

The above description of the character of the numerical variation and of its relations to lateral deformities of the spine represents a short, by no means complete, and somewhat schematic summary of a longer series of studies which have been made on the collection of 54 spines showing numerical variation, collected by Prof. Thomas Dwight, director of the anatomical department of Harvard University Medical School.[2] It is impossible to give here a full account of these studies, but I would like to illustrate, by means of three specimens of the Dwight collection, the morphological character of some forms of numerical variation, and the way in which they produced lateral deformities. These types[3] are shown in Table II, Figs. 9, 10, 12, 13.

The character of the variation in Fig. 9 resembles the one represented in diagram 4 with the sole difference, that in Fig. 9 the sacrum begins on both sides one vertebra lower. It will be noted in Fig. 9 that the spine shows A PRIMARY LUMBO-SACRAL CURVE to the left and that the twenty-fifth and twenty-sixth vertebræ, that is, the lumbosacral and first sacral vertebræ, show a special deformity of their bodies.

Fig. 10. This spine corresponds very nearly to diagram 5. We find attached to the seventh vertebra on the left side a markedly developed cervical rib, which is nearly a first dorsal in character, while on the right side we see a less developed cervical rib. The eighth vertebra has on the right a rib of transitional character, resembling in part the normal first, in part the normal second rib; the same

vertebra has on the left side a rib also of transitional character but resembling in its features and sternal attachment much more the normal second rib. The spine shows A DORSAL KYPHO-SCOLIOSIS TO THE RIGHT; and the chest with a prominence posterior on the right and anterior on the left is typical of the conditions we find clinically in some cases of "lateral curvature."

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[2] Dwight: Description of the Human Spines showing Numerical Variation, in the Warren Museum of the Harvard Medical School. Memoirs of the Boston Society of Natural History, vol. v, 1901. An abstract appeared in the Anatom. Anzeiger, Bd. 15, 1901.

Dwight: Numerical Variation in the Human Spine with a Statement Concerning Priority. Anatom. Anzeiger, Bd. xxviii, no. 1 und 2, 1906.

[3] No. 9379–15, 9379–53, 9379–34, in the Dwight Collection.

Figs. 13 and 14 illustrate spine No. 9379–34 from the Dwight collection. This spine shows a fusion of the last three lumbar and the first sacral vertebræ. However, what especially interests us here is THE VARIATION OF THE "ARTICULAR CHANGE." This is best seen in an x-ray taken from the lumbo-dorsal region of this specimen. (Table VII, Fig. 33.) The nineteenth vertebra has rudimentary ribs.

Between the eighteenth and nineteenth vertebræ there is on both sides a joint of neither lumbar nor dorsal but of transitional character. (The dorsal joint character may be observed in the joints above, the lumbar type in the joints below the abnormal one. Only the lumbar joints show in the x-ray the space between the articular processes.)

The inferior processes of the eighteenth vertebra on both sides possess chiefly dorsal character, while the superior processes of the nineteenth vertebra only in part show a corresponding type. This is especially marked on the left, where the superior articular process of the nineteenth vertebra for the most part shows lumbar character. These conditions correspond somewhat with those in diagram 7. Thus we find the left inferior process of the eighteenth vertebra articulating abnormally with the corresponding superior process of the nineteenth, so that it lies partly in front of it. This lack of conformity between the articular processes in this case has produced a sharp angled LUMBO-DORSAL DEVIATION in a lateral, posterior and rotary direction as is to be seen in Table II, Figs. 12 and 13. Fig. 33 also shows how the curve starts directly from the abnormal joint.

These three specimens of the Dwight collection may suffice to show that certain types of numerical variation may lead to certain distinct lateral deformities of the spine, and thus gain PATHOLOGICAL SIGNIFICANCE.

It may be emphasized here, that about *one third of the spines* of the Dwight collection show these *pathological types* of numerical variation, above determined, and consistent with them mostly slight lateral deformities *with* structural changes in the vertebral bodies.

Not only for the study of the relation between lateral deformities and numerical variation but also in another way the Dwight collection has proved to be of the greatest value for this research. It was used as the basis for answering the following questions:

1. Do THE TWO SEXES differ in regard to the type of numerical variation?

2. Does the variation affect the RIGHT AND LEFT SIDES of the spine in different ways?

After certain spines *f. i.* from negroes, of uncertain sex or identity were ruled out, 41 spines remained, 24 male and 17 female. Twenty-three spines varied in a cranial, 18 in a caudal direction.

In answer to the first question the following table shows the incidence of the two kinds of variation in the two sexes:

	Male.	Female.	Total.
Variation in the cranial direction	8	15	23
Variation in the caudal direction	16	2	18
Total	24	17	41

In answer to the second question the following may be said: Among the 41 spines 7 show a symmetrical and 34 an asymmetrical variation. Among the latter 18 vary in a cranial, 16 in a caudal direction. These 34 spines with asymmetrical variation were examined with reference to whether the left or right side varied more in the direction of the total variation.

The following table gives the result. In the column X are registered those aberrant forms of variation in which the single regions vary irregularly as to the side involved and which cannot be considered here.

Greater Variation on:	Left Side.	Right Side.	X.	Total.
Variation in the cranial direction .	12	3	3	18
Variation in the caudal direction .	3	11	2	16
Total				34

In the light of these observations the questions propounded above can be answered as follows:

1. THE FEMALE SPINE HAS A MARKED TENDENCY TO VARY IN A CRANIAL, WHILE THE MALE SPINE HAS A STRONG TENDENCY TO VARY IN A CAUDAL DIRECTION.

2. THE LEFT SIDE OF THE SPINE HAS A STRONG INCLINATION TO VARY IN A CRANIAL, THE RIGHT SIDE TO VARY IN A CAUDAL DIRECTION.

Thus: Considering the spine of both sexes together, THE LEFT SIDE SHOWS IN ITS VARIATION THE SAME RELATIONSHIP TO THE RIGHT SIDE AS DOES THE FEMALE SPINE TO THE MALE SPINE.

The importance of these findings for our subject will be shown later.

CLINICAL PART.

(From the Orthopedic Department of the Massachusetts General Hospital.)

If it has been demonstrated in the anatomical part that the peculiar developmental error which leads to numerical variation of the spine may in certain distinct cases lead at the same time to lateral deformities, in the clinical part we have to reverse the question in the following way:

Do cases of juvenile lateral deformities of the spine, such as are called commonly "lateral curvature," show the anomalies above described so frequently that an undoubted causal connection between them becomes apparent? Do cases of "lateral curvature" show numerical variations at the seat of the primary curve, and represent these variations those "pathological" types we would expect to find there in view of the results above detailed in the anatomical part?

From Jan. 1 to Oct. 1, 1906, I have studied 24 cases of "lateral curvature." In all of these cases an origin from poliomyelitis, rickets, empyema or purely static conditions was carefully ruled out. In accordance with exact measurements the cases were classified into the following groups:

1. Lumbo-sacral scoliosis.
2. Cervico-dorsal scoliosis.
3. Lumbo-dorsal scoliosis (including the "total" scoliosis).
4. Combined scoliosis; *i. e.*, spine in its parts equally deformed.

The measurements were made in the medico-mechanical department of this hospital by means of the Zander apparatuses for back and chest measurement and of a little instrument designed for measuring the back in forward-bending, which is an imitation of Beely's cyrtometer.

Table IV, Figs. 18–21, show the clinical types of the curvatures, under which the cases were classified. The photographs of the patients, from which the measurements were taken, Table III, Figs. 14–17, will help others to understand this classification.

RÖNTGENOLOGICAL PART.

(From the X-Ray Laboratory of the Massachusetts General Hospital.)

The spine of each patient was thoroughly examined by means of x-rays. The technique will be described here specially for the benefit of other workers. In the first place 3 plates of the spine were taken with the patient lying down: (1) of the dorsal spine and thorax with the neighboring lower cervical and upper lumbar parts; (2) of the lumbar spine with the neighboring lower dorsal and sacral region; (3) of the cervical spine. In order to count the cervical spine it is necessary to show the atlas in the picture. This can be attained by x-raying the neck with the patient's head turned to one side.

If we succeed in getting thus clear plates they may be sufficient to form a composite picture of the whole spine. But in many cases it is necessary to take besides these gross pictures detail pictures of certain interesting places with the compression cylinder. The piecing together of the detail pictures has to be done in strict comparison with the gross pictures. Finally a lateral picture of the occipito-cervical region must be taken. This picture is of special importance in cases of the cervico-dorsal group.

In the way just described *all the twenty-four cases* were examined,[4] and an exact knowledge of the numerical and morphological conditions of the spine has thus been gained. Four spines may be shown here as types. Table VI, Figs. 26–29. They are taken from the patients, whose measurements are shown in Table IV, Figs. 18–21; compare also photographs Table III, Figs. 14–17.

The results of the clinical and Röntgenographic examinations are briefly given in the following table:

The table shows the following: Three cases, Nos. 4, 5 and 6, belong apparently, clinically as well as anatomically, to the class of scoliosis, which at present are called "congenital." They do *not* show a numerical variation of the spine.

A fourth case, No. 3, does not allow a proper clinical or anatomical classification.

The other 20 cases form clinically a separate group, inasmuch as the onset of the deformity in these cases takes place in about the first half of the second decade of life. They belong to that large class of idiopathic scolioses, which we mostly see in schoolgirls and which is, according to the present conception, usually considered as due to faulty attitude, and therefore called habitual scoliosis. In all these 20 cases we find a numerical variation of the spine present. According to Bardeen's[5] recent statistical researches 15 to 16 per cent. of all human beings show one or the other numerical variation of the spine. The extreme frequency of variation in these 20 scoliotic spines suggests some relation between "habitual" lateral curvature and numerical variation of the spine.

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[4] In few cases cervical spine and occipito-cervical region has been omitted.

[5] C. R. Bardeen: Numerical Vertebral Variation in the Human Adult and Embryo. Anatom. Anzeiger, Bd. xxv, Jena, 1904.

The x-rays show, furthermore, in 16 out of these 20 cases the chief variation at the primary seat of the scoliosis, and just those "pathological" types of numerical variation which we would have expected to see in view of the results obtained from our anatomical studies.

Thus we have to answer the question which we put at the beginning of the clinical part, in regard to these 16 cases, in the affirmative.

These facts compel us to consider *in these 16 cases of "habitual" lateral curvature* (Nos. 1, 2, 7, 8, 9, 11, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24) *that the variation found is the cause of the lateral deformity present.*

In the face of this logical conclusion all theoretical objections must take a second place. There may be one chief objection based upon the following considerations which naturally come forward: As the table shows, the deformity in the 20 cases of "habitual" scoliosis first becomes noticeable usually between the tenth and sixteenth years or, on the average, at about fourteen years; but the cause, according to this theory, is a congenital one.

This seems to be inconsistent with the truth of the theory if we accept the clinical dogma that congenital deformities must show directly after birth.

If we insist upon the correctness of our x-ray findings, and upon the truth of our conclusions, this dogma must be wrong. And, indeed, it is wrong as to spinal deformities.

If we compare spine and chest of a new-born child with those of an individual at the time of the puberty, we shall come to the following conclusions:

The spine and chest at the time of birth are, as to their form and structure, to be regarded as unfinished. They undergo, during their development from birth to puberty, not only marked quantitative but also qualitative changes. Besides the disproportional longitudinal growth of the lumbar spine (Aeby, Moser and others) and the fixation of

I.

No.	Race.	Sex.	Age.	Age at which deform. was first noted.	Clinical diagnosis.	Morphological and numerical conditions of spine.	Anatomical diagnosis.	Illustrations.
1	white	female	15	12 years	left lumbosacral scoliosis	7 c. 12 d., last ribs overdeveloped, 5 l., 1 ls., 4 s., 1 sco.	Asymmetrical variation in a caudal direction.	Fig. 14 Fig. 18 Figs. 22 and 26 Diag. 8
2	white	female	17	16 years	left lumbosacral scoliosis	7 c., 12 d., last ribs overdeveloped, 1 ld., 5 l., 1 ls., 4 s. Pelvic-halves are of marked primary asymmetry.	Asymmetrical variation in a caudal direction.	
3	white	female	38	unknown	left lumbosacral scoliosis	12 d., 6 l.	Variation	
4	white	female orphan	18	ever since "she can remember."	right lumbosacral scoliosis	12 d., 2 l. Fusion of three last lumbar and first sacral vertebræ. Open canalis sacralis. Spina bifida occulta.	Congenital fusion of vertebræ	
5	white	male	12	7 years (uncertain)	left lumbosacral scoliosis.	12 d., 5 l. First sacral vertebra shows signs of imperfect development, for instance ununited arch.	Congenital lack of vertebral development	
6	black	male	10	18 months	left lumbosacral scoliosis	7 c., 12 d., 5 l. First sacral vertebra has exactly the same appearance as in Case V.	Same	

II.

No.	Race.	Sex.	Age.	Age at which deform. was first noted.	Clinical diagnosis.	Morphological and numerical conditions of spine.	Anatomical diagnosis.	Illustrations.
7	white	female	21	14 years	right cervico-dorsal scoliosis	6 c., 1 c.d, 11 d., 5 l., 1 ls. On the eighth vertebra there are ribs attached, from which the left resembles more the normal second, the right more the normal first rib.	Asymmetrical variation in a cranial direction	
8	white	female	20	16 years	right cervico-dorsal scoliosis	6 c., 1 cd., 12 d. Last ribs rudimentary, 5 l. The character of the ribs attached to the eighth vertebra are much as in the former case.	Asymmetrical variation in a cranial direction	Fig. 15 Fig. 19 Figs. 23 and 27
9	white	female	16	13 years	right cervico-dorsal scoliosis	Atlas fused to occiput, 6 c., 1 cd., 11 d., 5 l., 1 ls., *i. e.*, incompletely sacralized. Ribs attached to eighth vertebra are rudimentary, on the right more than on the left.	Asymmetrical variation in a caudal direction	
10	white	female	15	14 years	right cervico-dorsal scoliosis	6 c., 1 cd., 12 d. Last ribs rudimentary, 4 l., 1 ls., Ribs attached to eighth vertebra are *both* in shape more like normal second ribs.	Symmetrical variation in a cranial direction	
11	white	female	16	11 years	right cervico-dorsal scoliosis	7 c., third and fourth improperly developed, 1 cd., 11 d., 5 l. The right rib of the eighth vertebra is rudimentary.	Asymmetrical variation in a caudal direction	
12	white[1]	male	13	11 years	right cervico-dorsal scoliosis	Atlas fused, 6 c., 12 d., 5 l., 5 s., 1 sco. Ribs attached to eighth vertebra are *both* somewhat rudimentary.	Symmetrical variation in a caudal direction	Fig. 30 Table VII
13	white	female	13	12 years	right cervico-dorsal scoliosis	Atlas (?) 6 c., 1 cd., 11 d., Last ribs overdeveloped, 5 l., 1 ls. The left rib of the eighth vertebra is rudimentary.	Asymmetrical variation in a caudal direction	Fig. 31 Table VII
14	white	female	20	18 years	left cervico-dorsal scoliosis	Atlas fused, 6 c., 1 cd., 11 d., 5 l. The left rib of the eighth vertebra is rudimentary.	Same	

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[1] There is a decided heredity in this patient's history: Two brothers of his, one sister and one aunt of his mother have "lateral curvature" of the spine.

III.

No.	Race.	Sex.	Age.	Age at which deform. was first noted.	Clinical diagnosis.	Morphological and numerical conditions of spine.	Anatomical diagnosis.	Illustrations.
15	white	female	15	14 years	lumbo-dorsal scoliosis. Convexity right	7 c., 11 d., 1 ld., 5 l. Articular change between eighteenth and nineteenth vertebræ: right complete, left incomplete.	Asymmetrical variation in a cranial direction	
16	white	female	16	15 years	lumbo-dorsal scoliosis. Convexity left	7 c., 11 d., 5 l., 1 ls. (incompletely sacralized). Articular change between eighteenth and nineteenth vertebræ, left complete, right incomplete.	Asymmetrical variation in a cranial direction	Fig. 16 Fig. 20 Figs. 24 and 28
17	white	female	16	14 years	lumbo-dorsal scoliosis, but impure	7 c., 11 d., 1 ld., 5 l. The ninth dorsal vertebra is a semi-vertebra; artic. change (?)	Variation in a cranial direction and congenital lack of vertebral development	
18	white	female	16	14 years	lumbo-dorsal scoliosis. Convexity left	Atlas fused, 6 c., 12 d. Last ribs overdeveloped; 1 ls. Articular change between nineteenth and twentieth vertebræ: left complete, right incomplete.	Asymmetrical variation in a caudal direction	
19	white[2]	female	13	13 years	lumbo-dorsal scoliosis. Convexity left	(?) c., 11 d., 1 dl., 5 l. Art. change above dl. vert.: left complete, right incomplete.	Asymmetrical variation in a cranial (?) direction	
20	white	female	16	12 years	lumbo-dorsal scoliosis. Convexity right	Atlas fused, 6 c., 1 cd. (?), 11 d., 5 l. Articular change between nineteenth and twentieth vertebræ: right complete, left incomplete.	Asymmetrical variation in a caudal direction	
21	white	female	18	17 years	lumbo-dorsal scoliosis. Convexity right	(?) c., 11 d., 1 dl., 5 l., 6 s. Articular change see Fig. 32, Table VII.	Asymmetrical variation cranial (?)	

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[2] The deformity in this case is hereditary. The mother of the patient, as I could convince myself, has a scoliosis of the same type.

IV.

No.	Race.	Sex.	Age.	Age at which deform. was first noted.	Clinical diagnosis.	Morphological and numerical conditions of spine.	Anatomical diagnosis.	Illustrations.
22	white	female	23	17 years	Combined scoliosis, left lumbar, right dorsal	6 c., 1 cd., 11 d., 1 ld., 4 l., 1 ls.	Asymmetrical variation in a cranial direction	Fig. 17 Fig. 21 Figs. 25 and 29
23	white	female	22	14 years	Combined scoliosis, left lumbar, right dorsal	7 c., 12 d., last ribs rudimentary, 4 l., 1 ls. Ribs attached to eighth vertebra are both more of the character of the normal second rib.	Symmetrical variation in a cranial direction	
24	white	female	34	Patient is not conscious of having a scoliosis	Combined scoliosis, left lumbar, right dorsal	7 c., 1 cd., 11 d., 5 l., 1 ls. The right rib of the eighth vertebra is rudimentary.	Asymmetrical variation in a caudal direction	

REMARKS. The following abbreviations are used in this table: c=cervical, d=dorsal, l=lumbar, s=sacral, co=coccygeal, cd=cervico-dorsal, etc.

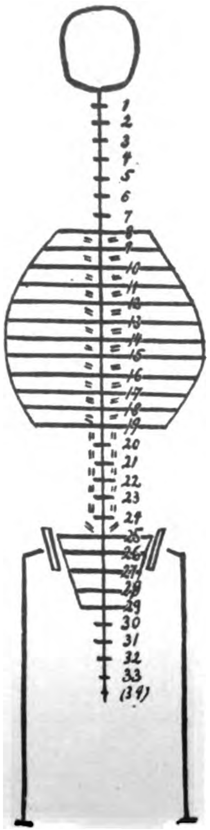


FIG. 1. Normal numerical conditions of the human spine.

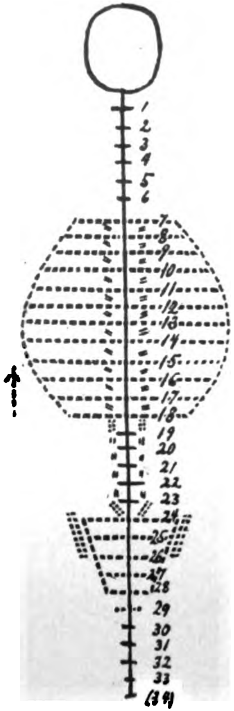


FIG. 2. Variation in a cranial direction.

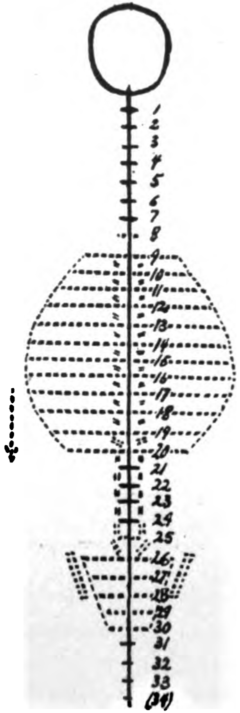


FIG. 3. Variation in a caudal direction.

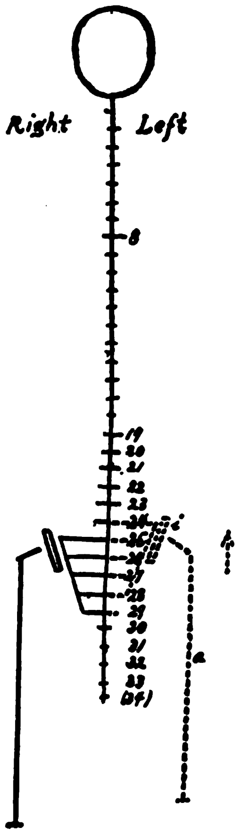


FIG. 4. Asymmetrical (cranial) variation of lumbo sacral region.

TABLE I.

Diagrams showing different kinds of numerical variation of the spine.

Diagrams 1-5 correspond to a front view, diagrams 6-8 to a back view of the spine.

TABLE I.—*Continued.*

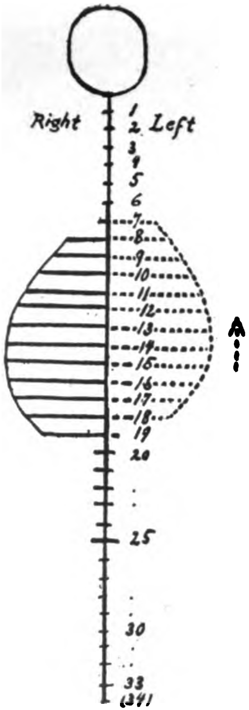


FIG. 5. Asymmetrical (cranial) variation of cervico-dorsal region.

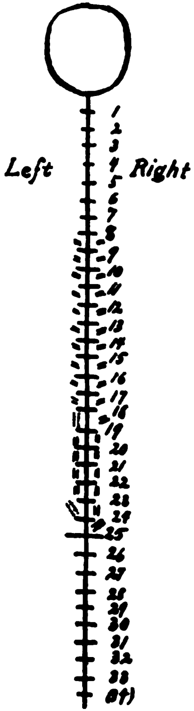


FIG. 6. Intervertebral joints in asymmetrical variation in cranial direction.

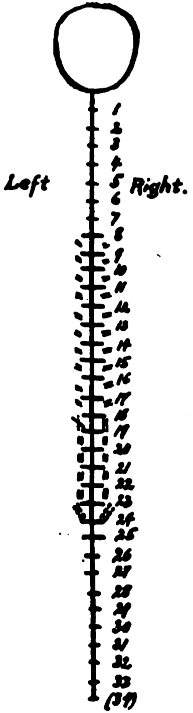


FIG. 7. Incomplete lumbo-dorsal articular change in variation in cranial direction.

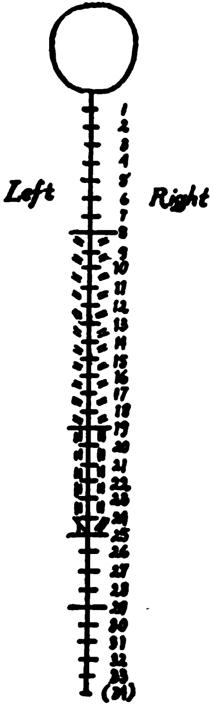


FIG. 8. Incomplete lumbo-sacral articular change in variation in caudal direction.

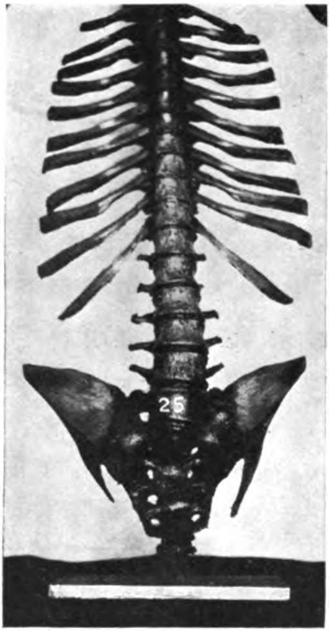


FIG. 9. Lumbo-sacral (caudal) variation and lumbo-sacral scoliosis.

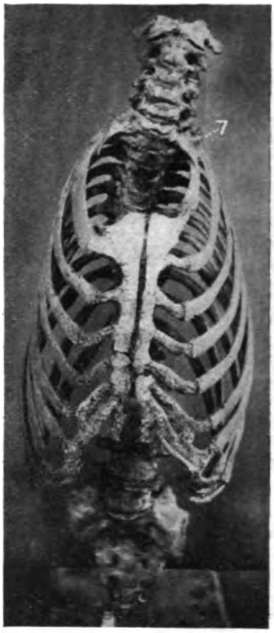
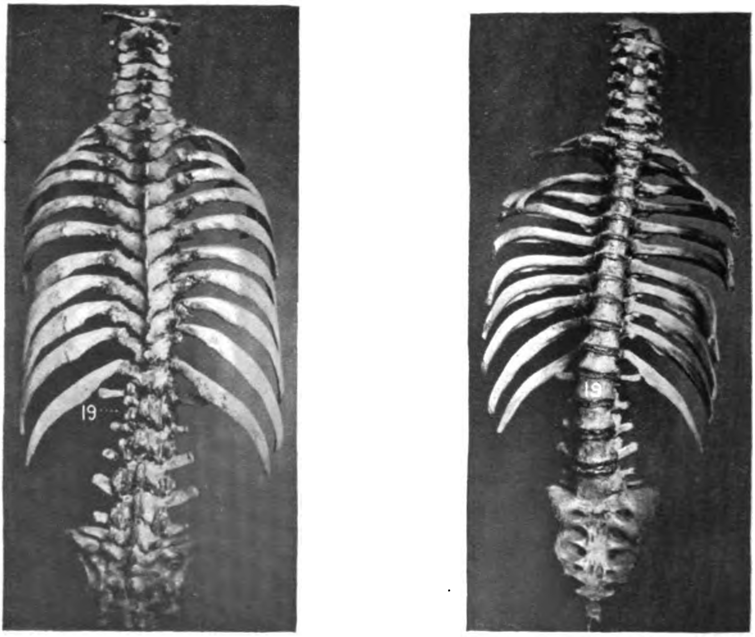


FIG. 10. Cervico-dorsal (cranial) variation and cervico-dorsal scoliosis.



FIGS. 12 and 13. Lumbo-dorsal (cranial) variation and lumbo-dorsal scoliosis; see also x-ray of this spine, Table VII, Fig. 33.

TABLE II.

Spines showing certain types of numerical variation consistent with the lateral deformity present.

From the Dwight Collection in the Warren Museum of Harvard University Medical School.

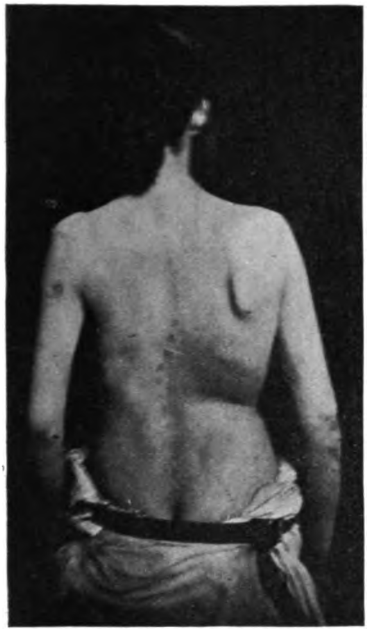


FIG. 14. Lumbo-sacral scoliosis. Case 1.

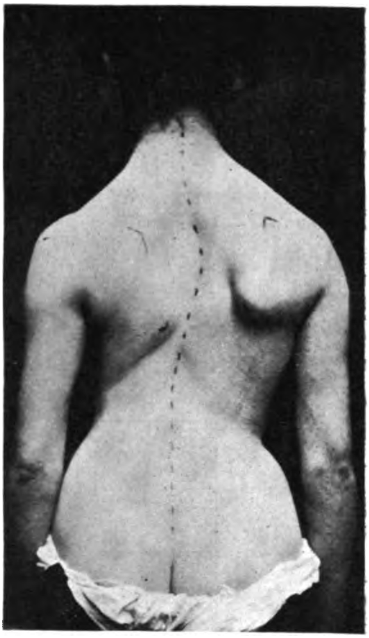


FIG. 15. Cervico-dorsal scoliosis. Case 8.

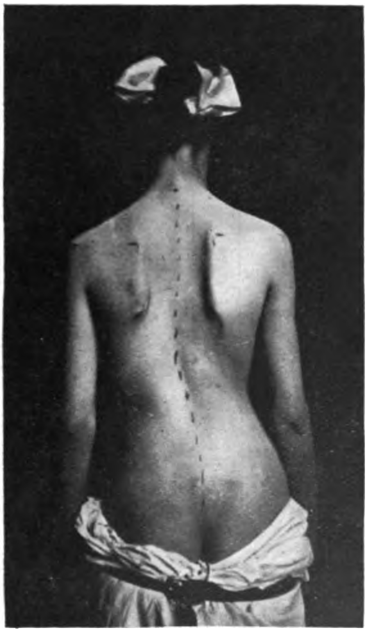


FIG. 16. Lumbo-dorsal scoliosis. Case 16.

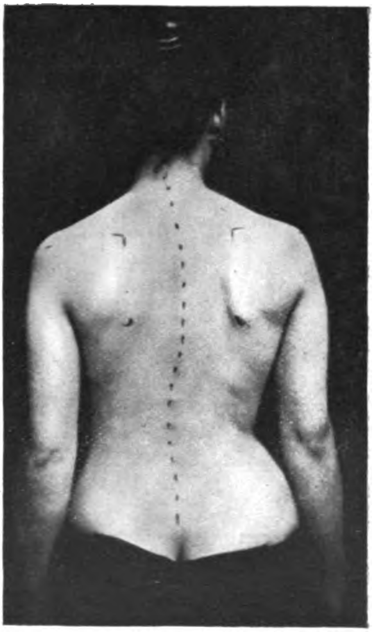


FIG. 17. Combined scoliosis. Case 22.

TABLE III.

Photographs from patients, whose measurements are given in Table IV.

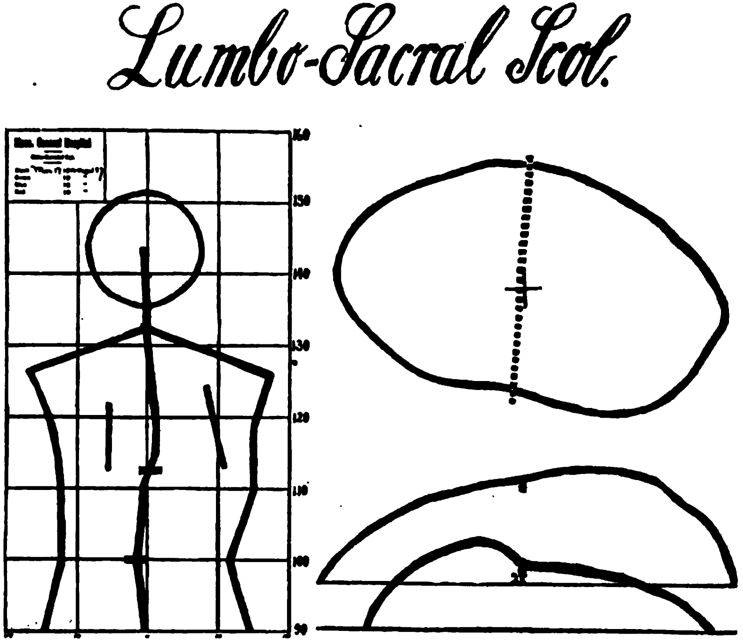


FIG. 18. From Case 1.

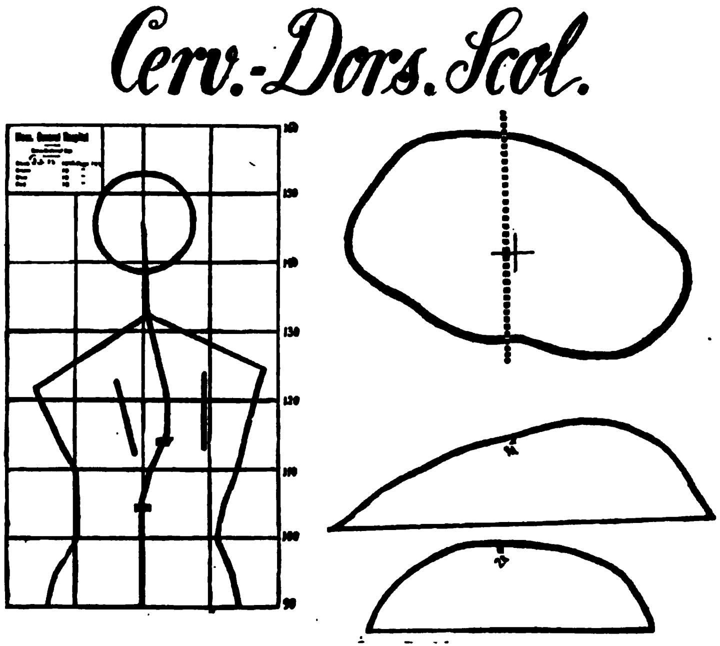


FIG. 19. From Case 8.

TABLE IV.

Measurements illustrating 4 different types of juvenile, so-called "habitual" scoliosis.

In the measurements are seen:

1. The back, in frontal view showing the outlines of the body, the line of the spinous processes, the position of the head, the basis of the shoulder blade. This picture is taken by the Zander apparatus for back measurement.

2. The chest circumference: the cross-line in this picture represents the connection of the spinous process with the middle of the sternum. This picture is taken by the Zander apparatus for chest measurement.

3. The upper part of the back, corresponding to the lower third of the dorsal spine, in forward bending.

4. The lower part of the back, corresponding to the middle of the lumbar spine, in forward bending.

The latter two measurements are taken by a little instrument which is an imitation of Beely's cyrtometer.

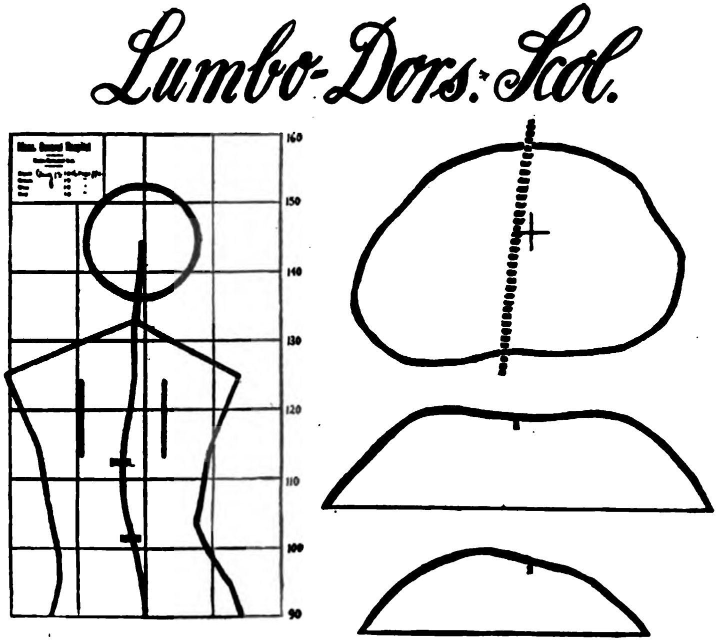


FIG. 20. From Case 16.

TABLE IV.—*Continued.*

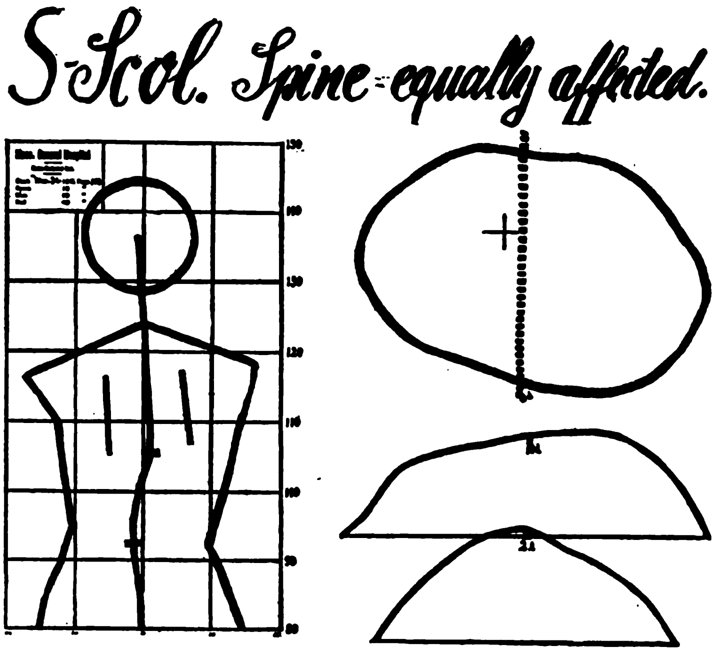


FIG. 21. From Case 22.

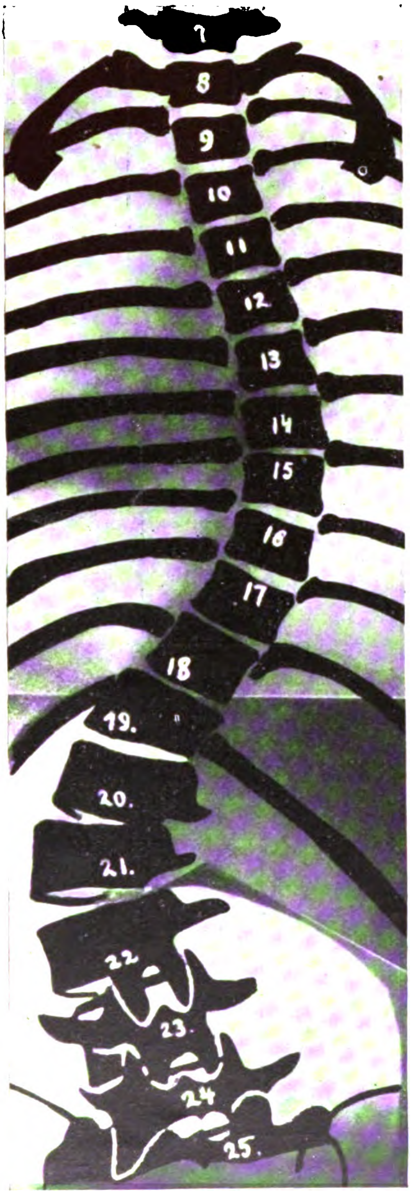


FIG. 22. Compare Fig. 26. 19th vert. has overdeveloped ribs; 25th vert. shows in its extended transverse processus the assuming of lumbar character. *Variation in a caudal direction.* Conditions of intervertebral joints see diagram 8. From Case 1.

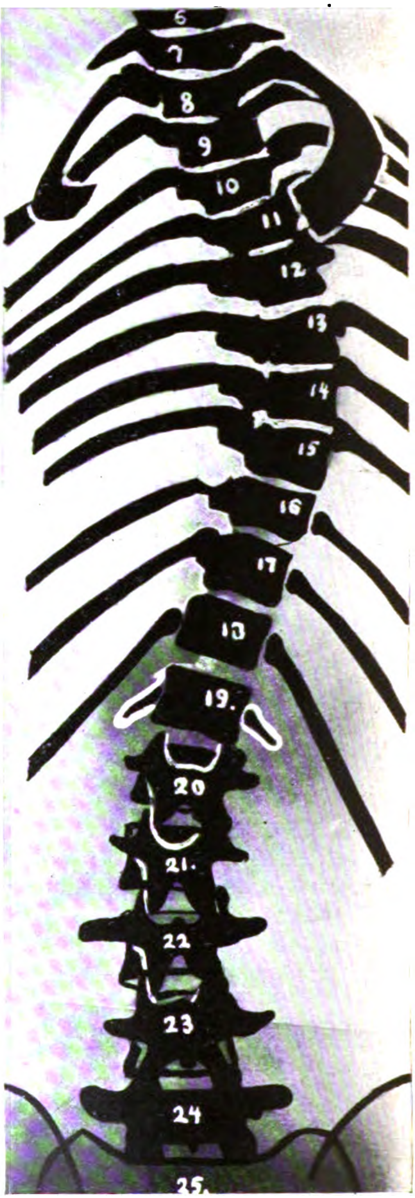


FIG. 23. Compare Fig. 27. 7th vert. has "cervical ribs"; 19th vert. bears rudimentary ribs. Lumbar spine normal. *Variation in a cranial direction.* 8th vertebra has on the left a rib, which in its shape and curve resembles a second rib, while the rib on the right in its shape and curve is almost a typical first one. From Case 8.

TABLE V.

Diagrams made from the original x-rays shown in Table VI.

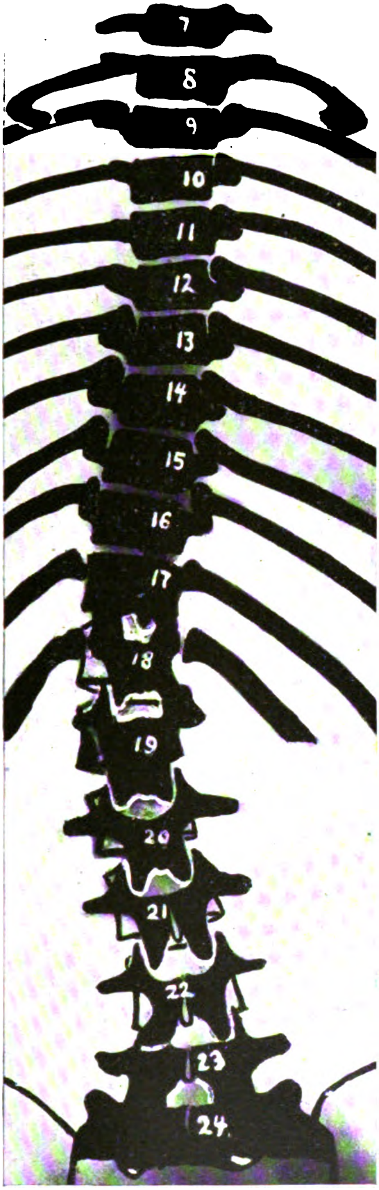


FIG. 24. Compare Fig. 28. 19th vert. does *not* bear ribs. 24th vert. is partly sacralized. *Variation in a cranial direction.* Lumbo-dorsal articular change takes place *above* the 19th vert. completely on the left side, in an incomplete and transitional manner on the right side. From Case 16.

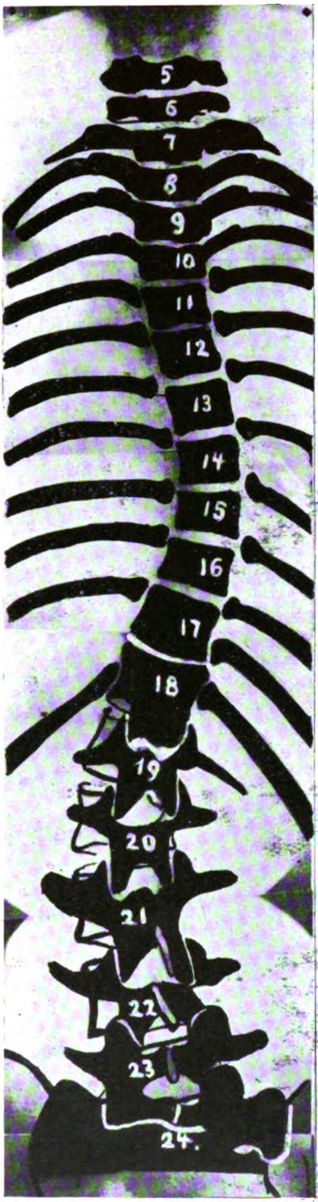


FIG. 25. Compare Fig. 29. 7th vert. bears "cervical ribs"; 19th vert. has a rudimentary rib on its right side; none on the left. 24th vert is sacralized on the left, while the right side is still of lumbar character. *Variation in a cranial direction.* Intervertebral joint between 23d and 24th vert. is on the left side sacral, *i. e.*, fused, on the right side lumbo-sacral.

Ribs attached to the 8th vert. show the assuming of the character of the normal second ribs, on the left more than on the right. (The x-ray which shows these conditions is not published here.) From Case 22.

TABLE V.—*Continued.*

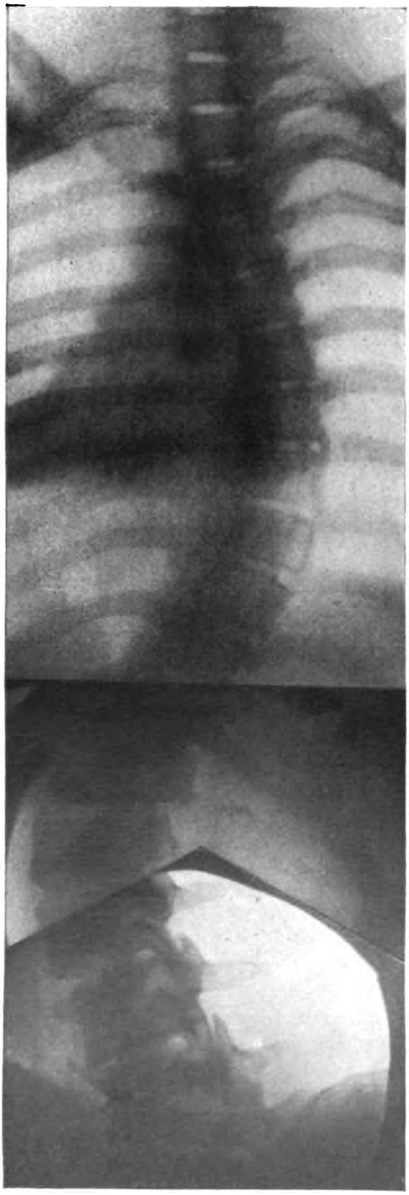


FIG. 26. Lumbo-sacral scoliosis. From Case 1.

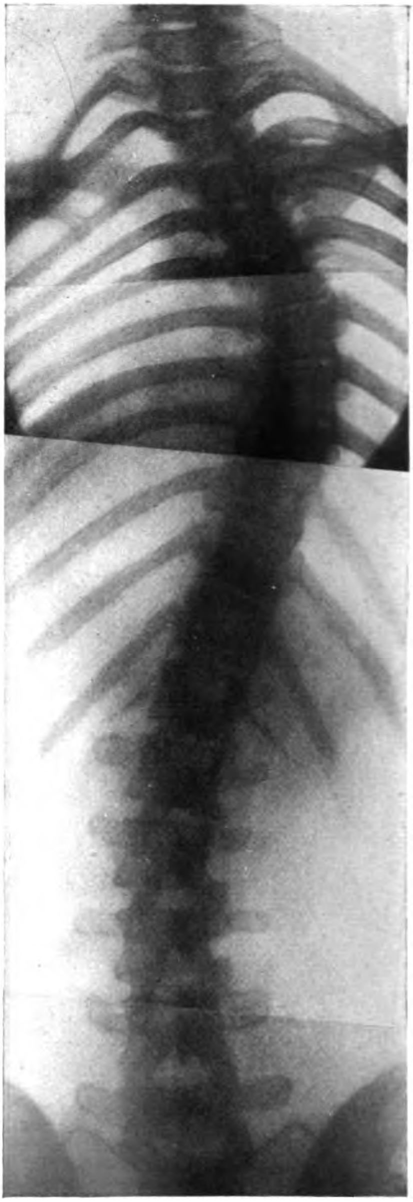


FIG. 27. Cerv. dors. Scol. From Case 8.

TABLE VI.

X-rays of the spines of the four patients, whose measurements and photographs are given in Tables III and IV.

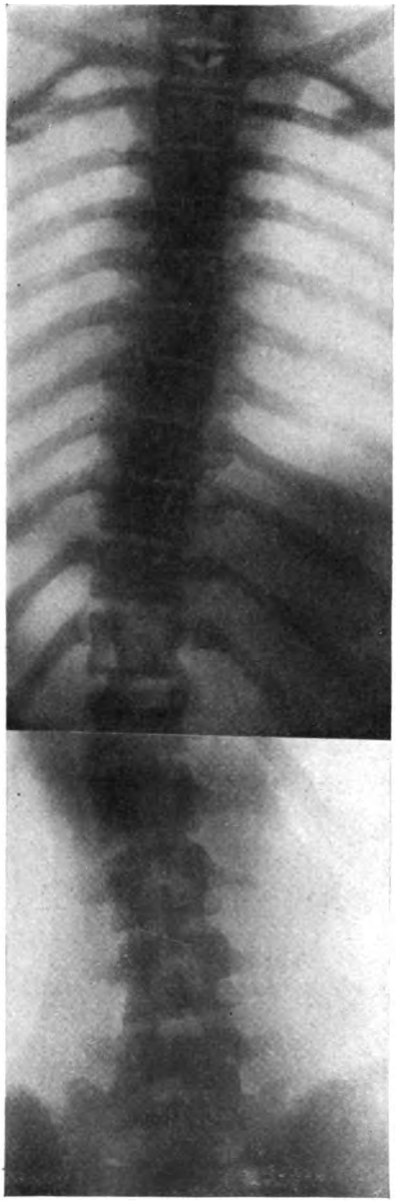


FIG. 28. Lumbo-dors. From Case 16.

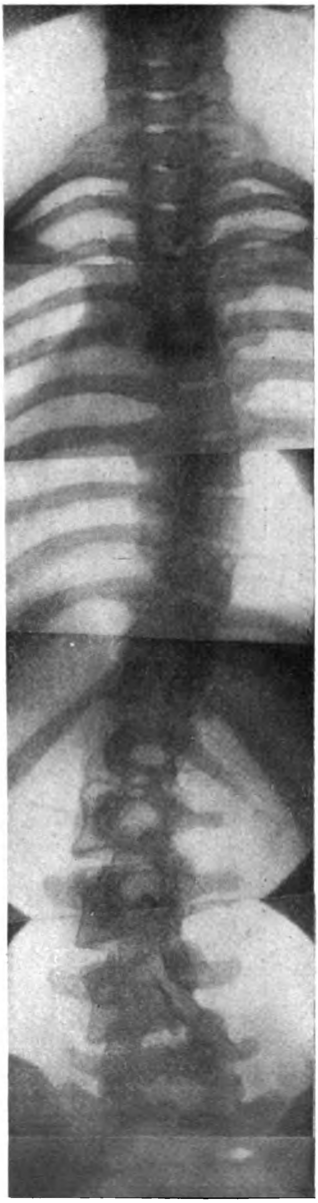


FIG. 29. Comb. Scol. From Case 22.

TABLE VI.—*Continued.*

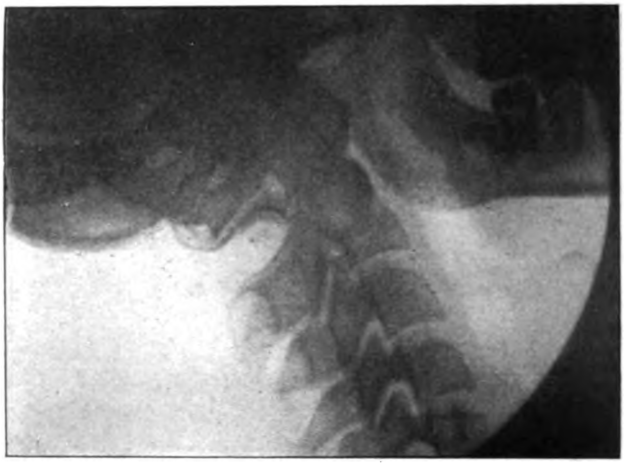


Fig. 30. From Case 12. Fusion of Atlas and Occiput.

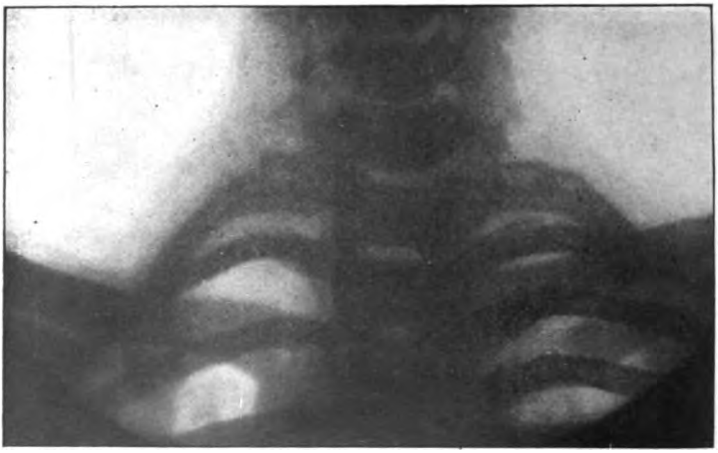


Fig. 31. From Case 13. Rudimentary first rib on the left.

Table VII.

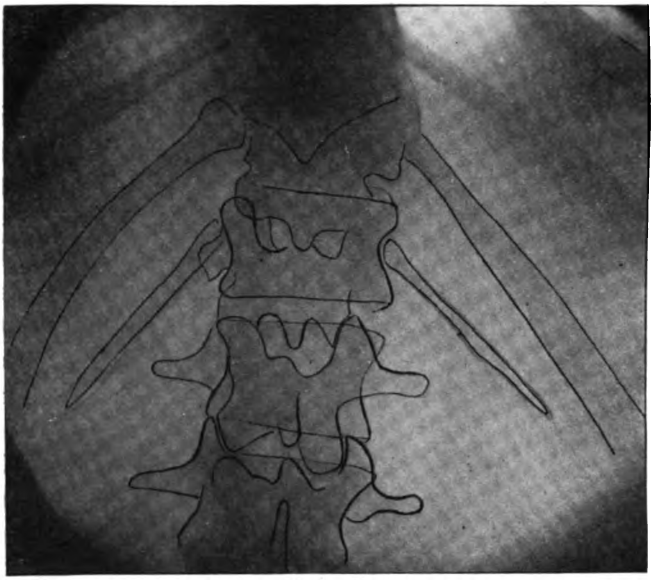


FIG. 32. From Case 21. Incomplete and asymmetrical lumbo-dorsal articular change. The right joint above the vertebra bearing rudimentary ribs has transitional character; in the left joint two articular processes of different character meet: the cranial process is of dorsal, the caudal of lumbar type. Tracing from the plate.

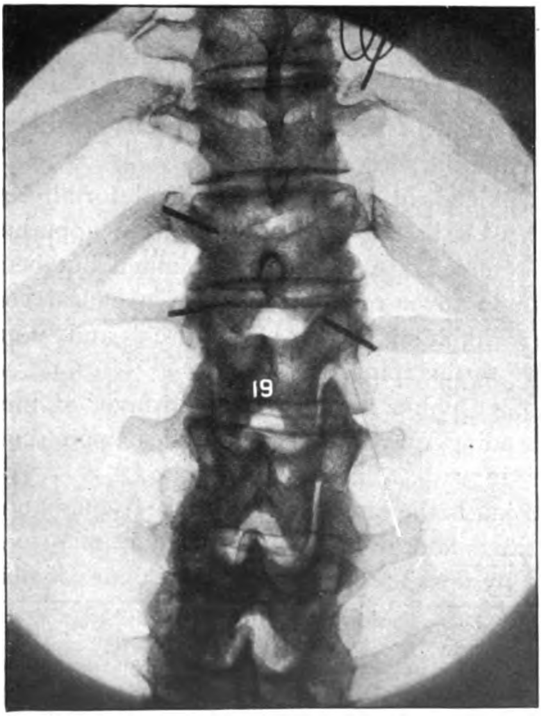


FIG. 33. X-ray from the specimen shown in Figs. 12 and 13. For description, see text.

TABLE VII. — *Continued.*

the normal lumbar curve, both of which physiological changes take place chiefly in the second decade of life, there are the following points of special interest for our present question:

(1) While in the embryo and in early childhood the chest grows chiefly in a sagittal direction, it extends chiefly in a frontal diameter at a later period. Out of the thorax of the child, the cross-section of which is heart-shaped, develops the chest of the man, the cross-section of which is bean-shaped.[6]

(2) The intervertebral joints in embryonic life and in early childhood have a uniform character which is of the dorsal type (Rosenberg). It is only in later life that the lumbar joints assume their definite character by turning their articular surfaces inwards. Consequently the "*articular change*" *does not develop* until this late period, which is about the beginning of the second decade.[7]

Clinical symptoms which are based upon abnormalities in this development, especially in the frontal growth of the ribs, and in the articular change, cannot possibly manifest themselves before the proper physiological conditions are present to allow of their development, *i. e.*, the first half of the second decade of life.

Since, indeed, in our 20 cases the deformity begins to manifest itself at this period of life, the apparent inconsistency referred to is not only explained but becomes an argument in favor of the theory of a causal connection between "habitual lateral curvature" and "numerical variation" of the spine.

Still other points may be urged in favor of the theory. Long standing questions in researches upon scoliosis are the following:

(1) What is the reason for the more frequent occurrence of "habitual lateral curvature" in the female sex?

(2) Why does the lumbar curve deviate usually with its

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[6] Hueter: Die Formentwickelung am Skelett des menschlichen Thorax. Leipzig, 1865.

[7] Merkel: Uber den Bau der Lendenwirbelsäule. Archiv für Anatomie und Entwickelungsgeschichte, Leigzig, 1877.

convexity to the left, and why the dorsal curve mostly to the right side?

The first question cannot yet be answered by this theory. For according to anatomical statistics, numerical variation of the spine is apparently more frequent among men than women. But it has been shown (page 132) that the female and the male spines have different tendencies in their variations, and it is likely that in the future in some way this difference in the spines of the two sexes may lead to a satisfactory answer to the first question referred to above.

The fact referred to in the second question stands in entire harmony with the theory here advanced. The description above given of the genesis of the primary lumbar and of the primary dorsal curve makes it clear in general that:

(1) The lumbar curve with its convexity will lie on the same side on which the ileum and the lumbo-sacral boundary are placed higher. (Compare diagram 4.)

(2) The dorsal curve with its convexity will lie opposite the side on which the ribs are longer, *i. e.*, opposite the side on which the cervico-dorsal boundary is moved up. (Compare diagram 5.)

These rules are *not* without exceptions, and no one will be surprised at this who considers that in the end the lateral deformity is the result of a developmental disorder of which the "numerical variation" of the spine may be only *one* sign.

Let us combine these rules with our findings described above: viz., that the left side has a pronounced tendency to vary in cranial direction, to move upwards. Thus we would easily understand why so frequently we find in "habitual lateral curvature" a deviation of the lumbar curve to the left, and of the dorsal curve to the right side.

To sum up all these arguments:

The anatomical studies teach us that certain "pathological" forms of numerical variation of the spine may cause certain kinds of lateral deformities.

The x-rays show that corresponding clinical types of "habitual lateral curvature" in the great majority of cases show the variation expected at the seat of the primary curve.

The "habitual" scoliosis manifests itself at the very time at which physiological growth and changes allow the appearance of curves, based upon a "varying" development.

The different affection of the two sides of the spine in "habitual lateral curvature" corresponds with the peculiar relation of the right and left sides of the spine to the numerical variation.

Based upon these arguments and upon the fact that, in 16 out of 20 cases of so-called "habitual" scoliosis those "pathological" types of variation were found at the primary seat of the deformity present, the following statement seems to be justified:

That developmental error of the human body occurring in embryonic life, which has its morphological expression in the so-called "numerical variation" of the spine, causes under certain circumstances those idiopathic lateral deformities of the spine which manifest themselves in the first half of the second decade of life and which hitherto have been considered as affections acquired in postnatal life owing to purely functional or functional-osteopathic conditions.

It seems to be the etiological factor of "habitual" lateral curvature, better now to be called delayed congenital scoliosis or scoliosis congenitalis tarda.

In concluding, I desire to thank here all those who have given me advice, help and assistance in carrying out the work.

First of all, I wish to thank Prof. Thomas Dwight, director of the Anatomical Department of Harvard University Medical School, for much instruction, for his great courtesy in placing his valuable collection at my disposal for study and publication. My thanks are furthermore due to Drs. Goldthwait and Osgood, surgeons to the

Orthopedic Clinic of the Massachusetts General Hospital, for the interest they have taken in the work and for the use of their material; to Dr. Painter, surgeon to the Orthopedic Clinic of the Carney Hospital, who placed his entire curvature material at my disposal; to Dr. Brackett, surgeon to the Orthopedic Clinic of the Children's Hospital, who has also supplied me with some cases.

I am especially indebted to Mr. Walter Dodd, director of the x-ray laboratory of this hospital, who perfected the technique of the x-ray examination and who has given me in many other ways valuable assistance.

Finally, I have to thank Dr. Frederic C. Kidner for help in the photographic work, and Miss Gavaghan at the Carney Hospital, and Miss Wilde at the Massachusetts General Hospital, for kind assistance.

BRAIN INJURIES.

1. GUNSHOT WOUND INVOLVING BOTH OCCIPITAL LOBES: STUDY OF VISUAL FIELDS.

2. FRACTURE OF SKULL: INJURY TO FRONTAL LOBE.*

BY HENRY C. BALDWIN, M.D., *of Boston.*

W. C. S. Thirty-four years. Service of Dr. James G. Mumford, Massachusetts General Hospital.

July 24, 1905, the patient was brought to the hospital with a history of having been shot five hours previous by the accidental discharge of a 32-caliber rifle. The bullet entered at the lower part of the right occipital region, and the direction of the bullet was diagonally upward.

I was asked to see the patient in consultation by Dr. Mumford. The patient was conscious, and had been ever since the accident. There were no paralyses of the face, arms and legs. The reflexes were all normal. The pulse was not slow. The only symptom that the patient had was total blindness. The pupils were widely dilated, and did not react at all. The diagnosis was made of injury to the visual centers in both occipital lobes. An x-ray showed that part of the bullet was lodged near the entrance of the wound on the right side, and that part of the bullet was in the occipital lobe on the left side. The point of entrance was very small, and it was recommended that large openings should be made over both occipital lobes to give good drainage.

Free openings were made by Dr. Mumford on both sides. On opening the skull on the right side, disorganized brain substance and considerable blood oozed out, and the finger of the operator went into a cavity. There was a hole through the falx cerebri, and a piece of bone was extracted from the left occipital lobe, which had been carried through the falx from the point of entrance. The piece of bullet located in the left occipital lobe was not found, and it was not deemed wise to risk doing any damage by searching for it. A recent x-ray shows a piece of bullet still remaining in the left occipital lobe.

The patient was totally blind the next day, but there were no other symptoms. Three days later the patient began to see a little, and his pupils became smaller and responded to light. There was no rise of temperature, and the patient had no symptom whatever except his impaired vision. Before he left the hospital, an examination by Dr. Tracy Eastman was made of his field

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[*] Read at a meeting of the Society of Neurology and Psychiatry, Nov. 16, 1905. Reprinted from the Boston Medical and Surgical Journal, Vol. cliv, No. 7, pp. 185-187, Feb. 15, 1906.

of vision and of the condition of his fundi. The field of vision was absent on the left side; there was about a quarter field of vision on the right side, the right eye having a larger field than the left, as shown by the diagram. The vision was 20-20 in the quadrant of each eye, and the fundi were normal. In this case the total blindness at first was due to destruction of the visual center in the right occipital lobe, and to injury and hemorrhage into the visual center of the left occipital lobe. Undoubtedly, the free openings that were made over both occipital lobes were largely instrumental in preventing sepsis, and the free drainage afforded aided the recovery of the injured center on the left side.

The patient reported to me Nov. 16, 1905. His field of vision had increased a little, as shown by the diagram. Dr. Alex. Quackenbos stated that the vision and fundus were normal. The patient told me that he had been out shooting and had been able to bring back partridges and squirrels.

The field of vision was taken by Dr. Robert G. Loring on Dec. 16, 1905, and the diagram shows an increase in the field of vision. The vision and fundi are normal.

Cases of gunshot wounds causing injury to both occipital lobes are rare. In the medical and surgical history of the Civil War, exclusive of cases that were fatal on the field, there were reported 4,350 cases of gunshot injuries of the cranium. Of these cases 2,514 died. There were 559 cases of penetrating and perforating wounds of the skull, 458 of which died. In looking over 119 cases that were given in detail I can find no case of injury to the occipital lobes reported. It is interesting to note that there are but 1,190 gunshot wounds to the eye reported, and that only 63 of these cases lost the sight of both eyes.

In his book entitled "Surgical Experiences in South Africa," Makins reports three cases of injury to the left occipital lobe and two cases of injury to both occipital lobes due to gunshot wounds. In one case of injury to the left occipital lobe, no mention is made of the field of vision, but in the other two cases there was hemianopsia. In the two cases reported of injury to both occipital lobes, the fields of vision were affected in both eyes.

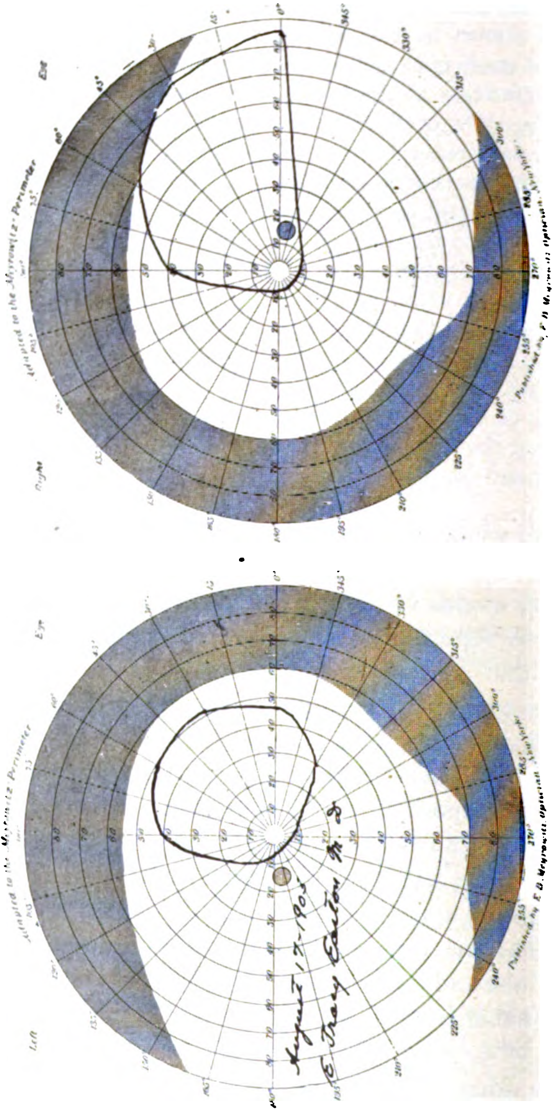

Left
Right
Adapted to the Meyrowitz Perimeter
Published by E. B. Meyrowitz, Optician, New York
August 17-1905
E Tracy Easton M.D.

FIG. 1.—Visual field, Aug. 17, 1905.

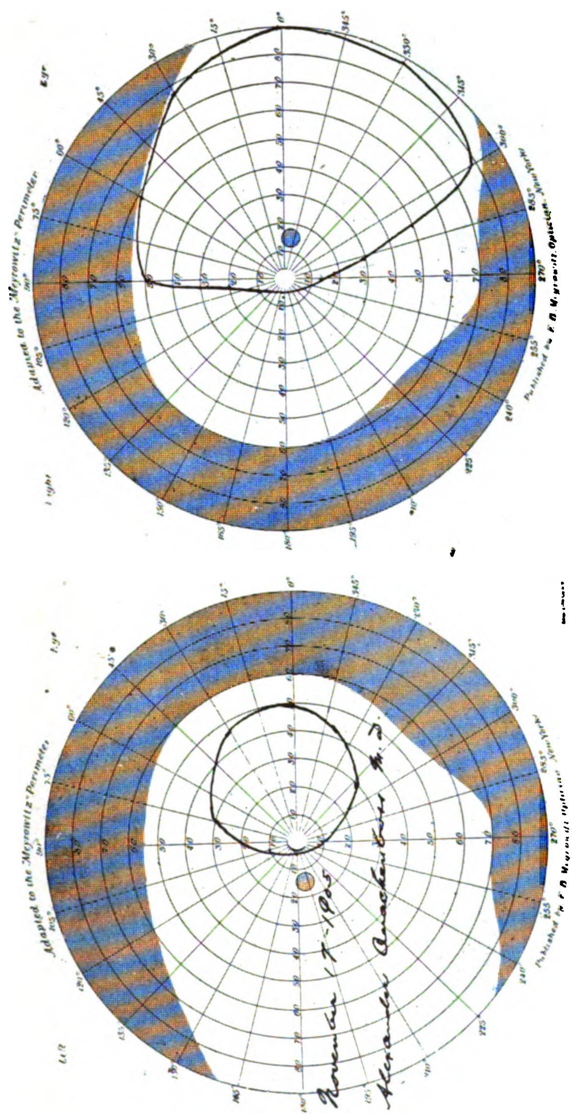
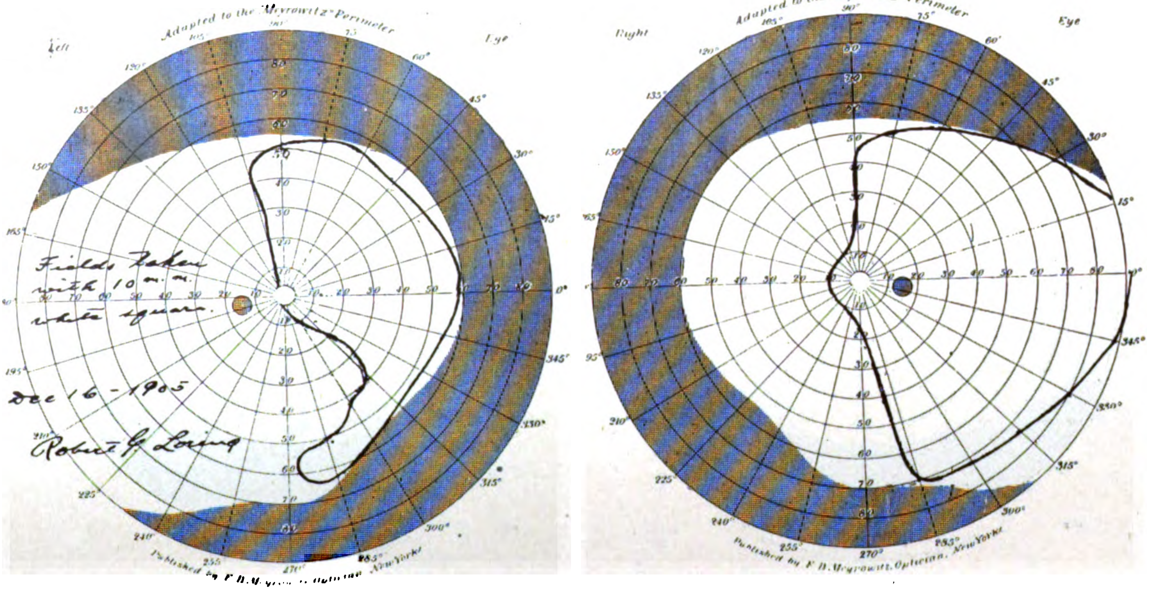

Adapted to the "Meyrowitz" Perimeter
Right Eye
Published by E. B. Meyrowitz, Optician, New York
Adapted to the "Meyrowitz" Perimeter
Left Eye
Published by E. B. Meyrowitz, Optician, New York
November 17 1905
Alexander Quackenbos M.D.

FIG. 2.—Visual field, Nov. 17, 1905.


Left Eye
Right Eye
Adapted to the "Meyrowitz-Perimeter"
Adapted to the "Meyrowitz-Perimeter"
Published by F. B. Meyrowitz, Optician, New York
Published by F. B. Meyrowitz, Optician, New York

Fields taken
with 10 m.m.
white square.

Dec 16 - 1905

Robert G. Loring

FIG. 3.—Visual field, Dec. 16, 1905.

MASSACHUSETTS GENERAL HOSPITAL.—SERVICE OF DR. W. M. CONANT.

C. E. H. Fifty-five. Man was struck and knocked down by an electric car, June 16, 1905. When brought to hospital was noisy, restless and apparently drunk. There was no disturbance of pupils or reflexes. There was fracture of the left clavicle; no fracture of the skull made out. There was no bleeding from ears, mouth or nose.

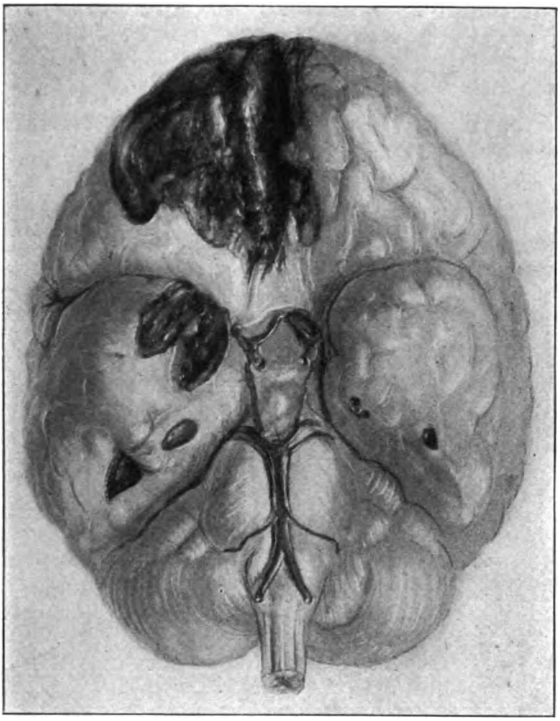


FIG. 4.—Showing injury with softening to frontal and temporal lobes.

The patient had nothing remarkable in the way of symptoms.

July 1, I was asked to see him in consultation with Dr. Conant, as a matter of routine and to express an opinion as to the advisability of his leaving the hospital. He had a normal temperature, his reflexes were all normal, and there was nothing remarkable about the pupils. The patient answered questions readily and correctly. There was an area of discoloration over the forehead running down into the right eye, which gave evidence of the patient's having received a very severe blow. The mental condition, though not confused, was dull, and the man seemed apathetic and slow in comprehending and answering. The diagnosis was "the results of concussion and alcoholism," and further observation was advised.

The patient became duller five days later, and died a week later after having run a septic temperature for a few days.

Before the autopsy I stated to the House Officer that they would find a fracture running through the frontal bone; that one of the anterior lobes of the brain would be found disorganized, and that the patient died from sepsis through the infection of this disorganized lobe, the entrance of the infection being through the nose. The picture shows the condition found.

This is the second case that I have seen of this kind. The first case was a man who was riding on a bicycle and ran into an electric car. He was not unconscious, and presented no symptoms for over two weeks, when he ran a temperature and died of sepsis. The right anterior lobe was even more disorganized than was the case in this instance.

These cases where the anterior lobe is seriously injured by direct violence have not been very common in my experience. Both patients had no symptoms that were localizing or that indicated mental disturbance. Their dullness and slowness of mentality were all the symptoms that indicated any brain trouble. In both instances it has seemed to me that, if the condition had been recognized, or rather suspected, operative treatment might have been effectual. Where such a condition was suspected, or where in a head case with a history of direct violence to the front of the head the patient began to run a temperature, it seems to me that it would be justifiable to make an exploratory incision to ascertain if there were a fracture of the skull. If such a fracture were found, an opening into the skull to afford free drainage would seem to give the patient a chance. Such an incision could be made in the hair line, the flap being turned down to give a view of the forehead. An opening through the skull on the side to avoid the frontal sinus would give good drainage to the anterior lobe.

CASE OF TUMOR OF SPINAL CORD CORRECTLY DIAGNOSTICATED; OPERATION; MARKED IMPROVEMENT.*

By Henry C. Baldwin, M.D.

A. O'D., single; aged twenty-nine.

Aug. 26, 1905, I was asked to see a patient who was said to have ataxic paraplegia, and who gave the following history: In January, 1904, she noticed that her right foot was numb and cold. This numbness increased until the entire leg was affected, and the leg became rigid. The right leg seemed as strong as the left leg, but she could not bend it at the knee and she dragged the toe. The following December the left leg became affected and rigid, and in about six weeks, that is, some time in February, 1905, she became unable to walk at all. She lost control of the sphincters of the bladder and rectum at this time. Some time in April she noticed that the palm of the right hand was not so full as formerly, and later the left hand became somewhat affected.

At the time that she noticed the slight wasting of the hand, there was some numbness on the outside of the arm in the ulnar distribution.

She was well nourished and had good color. There was marked contraction of the pupil of the right eye and narrowing of the right palpebral fissure which she had noticed for the previous year. There was no involvement of any cranial nerves. There was wasting more marked on the right side than on the left, in the ulnar and median distribution of both hands and arms, and there was disturbed sensation in the ulnar distribution. Both legs were rigid, and for the most part in the position of flexion. She was troubled with frequent jumpings of both legs, which caused her a good deal of annoyance. At times the legs would be crossed. There was curvature of the spine with a concavity toward the left. The patient complained of sweating and flushing on the right side of the body. On testing sensation there was anesthesia in both legs, and this anesthesia extended to the region midway between the umbilicus and the breasts. Above this point sensation was practically normal except in the ulnar distribution as stated. There was no disturbance of sensation to heat and cold when complete anesthesia was absent.

In both supraclavicular regions there were small nodules the size of a hen's egg. There was also a nodule in the right thigh. The diagnosis was made at this time of tumor pressing on the cord, probably multiple. The patient was sent into the hospital for observation and examination of tumors.

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*Reprinted from the Boston Medical and Surgical Journal, Vol. cliv, No. 22, pp. 623, 624, May 31, 1906.

The patient was asked about pain and said that she had had no pain from the beginning of her trouble.

Examination of the tumor removed from the right thigh showed it to be a fibro-sarcoma. Immediate laminectomy was urged. The opinion that the lesion was multiple, one tumor being located between the sixth and eighth dorsal vertebræ, and the other tumor between the fifth cervical and the first dorsal, proved to be incorrect.

A laminectomy Sept. 18 by Dr. C. L. Scudder in which the fifth, sixth and seventh dorsal vertebræ were opened, showed normal appearing cord at this level. On Nov. 7, a second laminectomy was performed by Dr. Scudder, the fifth, sixth and seventh cervical and first dorsal vertebræ being opened. An extradural tumor was found growing from the side of the fifth cervical vertebra. It was encapsulated and was removed. Microscopically it is a fibro-sarcoma.

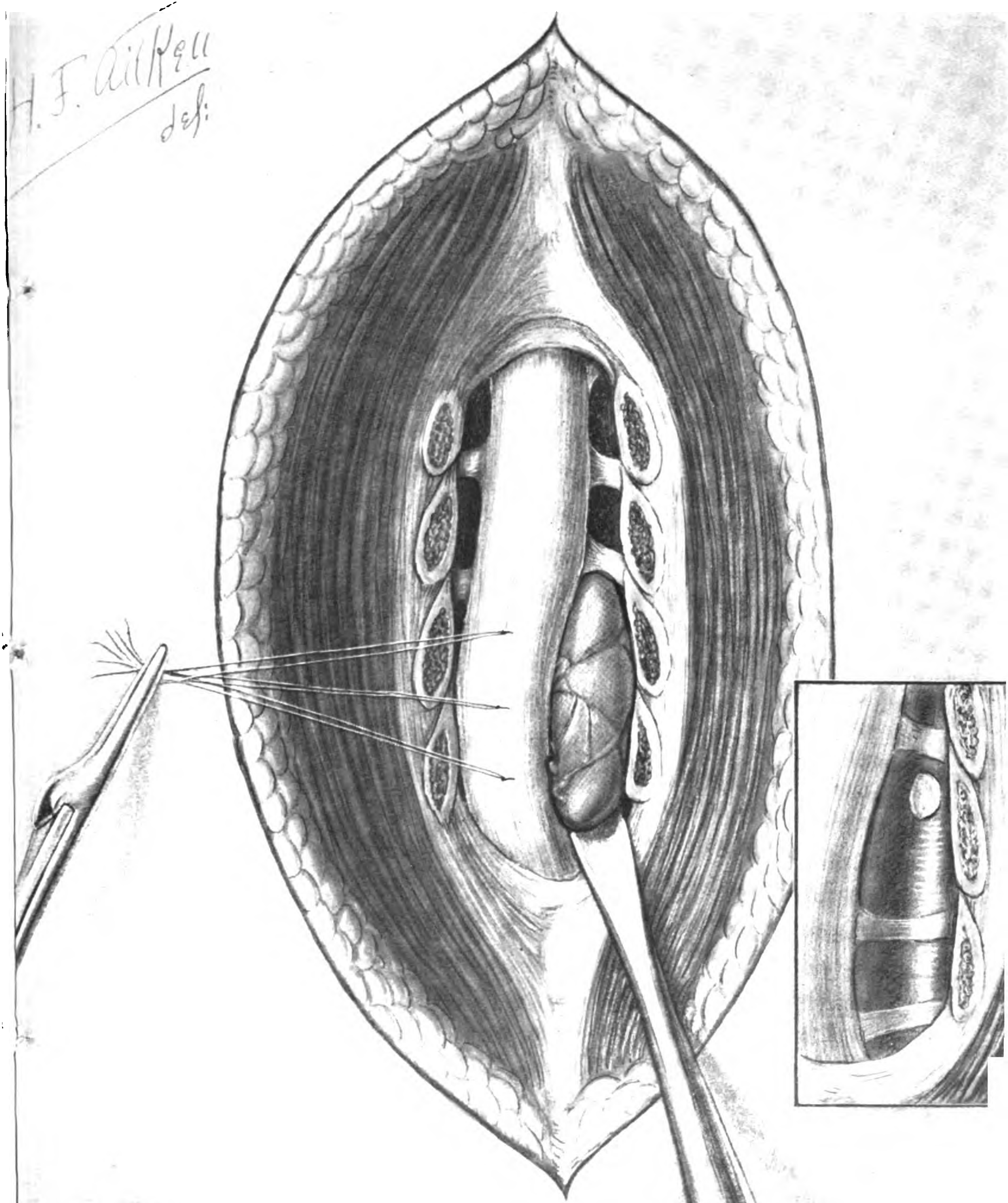
The tumor, for the most part, was situated anteriorly to the cord, and this situation accounts for the absence of pain, which is unusual, pain being considered one of the principal symptoms of tumor of the cord. The tumor extended downward and was about the size of a peach stone. The cord posteriorly did not look much compressed, but it was flattened and compressed especially on the right side and anteriorly, to such a degree that the question of any improvement from the operation seemed doubtful.

In both operations the dura was opened and afterwards stitched together.

The patient had no unusual symptoms after either laminectomy, and made a good recovery. Following the second operation there was hiccoughing for a period, which showed irritation of the phrenic nerve.

Sensation had returned in both legs within a week after the second operation. Early in December the patient moved the toes of her left foot, and a little later she regained complete control of the sphincters of the bladder and rectum, and began to move the toes of her right foot. The rigidity of the legs has gradually disappeared, and she can now straighten out her left leg and partially straighten out the right leg. Both legs have increased in size. The right hand and arm have grown larger, and she can now sew and write, which she could not do at the time of the operation.

Sensation is perfect everywhere. The narrowing of the right palpebral fissure and the contraction of the right pupil have improved now that the irritation of the first dorsal nerve no longer exists. The patient can stand on her left leg by holding on to something, and will probably soon be able to walk with crutches.



Tumor pressing on cord. The smaller cut at the right shows attachment to side of fifth cervical vertebra.

The patient has already improved far beyond the expectation at the time of the operation, and this recovery has been sooner than was looked for. There are undoubtedly some degenerative changes in the cord which will prevent perfect recovery, but there will be further improvement.

In 1898 Schlesinger,[1] in a monograph on "Tumors of the Spinal Cord and Vertebræ," reported four hundred cases of tumor of the spinal cord found in autopsies, over one-fourth of these being sarcoma. This was the number found in over 35,000 autopsies; and it is noted that tumor of the cord bears the relation to tumor of the brain in the ratio of one to thirteen.

In 1899 Putnam and Warren[2] collected thirty-three cases of tumor of the spinal cord that had been operated on up to that time.

In 1903 Starr[3] collected fifty-eight cases of tumors of the spinal cord where operation had been performed.

In 1905 Harte[4] analyzed 92 cases of operation for tumor of the spinal cord. In 72 cases tumors were found, in four the nature of the growth was not stated, 11 were cases of adhesions and 5 of syringomyelia.

Since Harte's paper was written Walton and Paul[5] have reported one successful and one unsuccessful case of operation for tumor of the spinal cord; Warrington has reported a successful case of operation for tumor of the cauda equina and two cases not included in previous lists was reported by Turner[6] of successful operations by Ballance at the National Hospital for Paralyzed and Epileptics in London.

Tumors in the cervical region are less common than elsewhere. Putnam and Elliott[7] (Boston) report one case of tumor of the second and third cervical vertebræ. This case was successfully operated upon, and seems to be the highest localized case on record. Putnam, Krauss and Park[1] (Buffalo) report a case of tumor at the level of the third cervical vertebra. The tumor which is now reported lay at the level of the fifth cervical vertebra. Woolsey,[2] Oppenheim,[3] Henschen,[4] Walton and Paul[5] and Cushing[6] each report a case of tumor lying between the sixth cervical and first dorsal vertebræ.

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[1] Schlesinger: Monograph, Jena, 1898.

[2] American Journal of Medical Sciences, 1899.

[3] Organic Nervous Diseases.

[4] Annals of Surgery. Phila., 1905.

[5] *Boston Medical and Surgical Journal*, 1905.

[6] The Clinical Journal, 1904.

[7] Journal of Nervous and Mental Disease, 1903.

Among the reported cases but eight tumors are in the cervical region, and this case is the third highest localized tumor.

Regarding the mortality, in the series of Putnam and Warren 16 died within a few days of the operation, and two within six months. Seven are reported as recovered, and improvement is noted in the remainder.

In the series reported by Starr, 32 died; 16 cases recovered from the operation and improved; 10 recovered from the operation, but did not improve because of the degenerative processes in the cord that had occurred previous to the operation.

In the series reported by Harte 43 died and 49 recovered; 29 are reported as cured; 17 improved, and 3 unimproved.

Undoubtedly to-day by improved technique the mortality from the operation is greatly reduced. The success of the operation, so far as the recovery of the patient is concerned, depends upon its early performance, as degenerative changes in the cord occur in consequence of continued pressure upon it.

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[1] Am. Journal of Medical Sciences, 1903.

[2] Med. News, 1904.

[3] Text Book Nervous Disease, 1904.

[4] Mitth. Grenz. Med. u. Chir. 1903.

[5] *Loc. cit.*

[6] Annals Surgery, 1904.

CASE OF TUMOR OF THE SPINAL CORD CORRECTLY DIAGNOSTICATED; SUCCESSFULLY OPERATED ON; PRESENT CONDITION.*

By Henry C. Baldwin, M.D.

Just a year ago this patient was successfully operated on by Dr. Charles L. Scudder for tumor of the spinal cord. The growth was a fibro-sarcoma, and grew from the side of the fifth cervical vertebra, being the size of a peach stone, and flattening and compressing the cord anteriorly. At that time the patient was absolutely helpless, with both legs rigid and flexed, so that the heels pressed against the buttocks. She had absolute loss of sensation below the umbilicus, and paralysis of the sphincters of both the bladder and rectum.

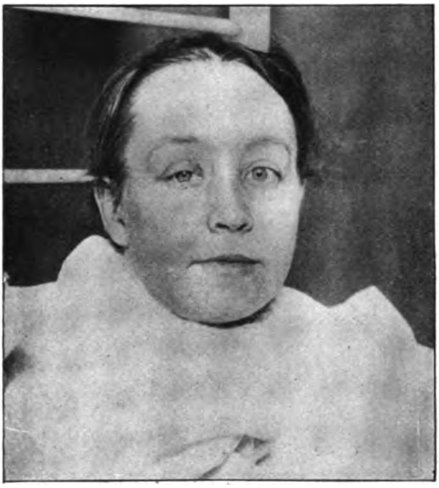

Fig. 1.—Patient at time of operation, Nov. 7, 1905. Shows narrowing of right palpebral fissure and contraction of right pupil due to irritation in the region of the first dorsal nerve due to pressure of the tumor. This has now nearly disappeared.

Sensation returned within a week following the operation, and control of the sphincters of the bladder and rectum in about two months. She began to move the toes of one leg in about six weeks, and gradually recovered some power of motion in both legs. When I showed her at the clinical meeting six months ago, she could straighten out the left leg and partially extend the right leg. She was sent into the hospital in June for two reasons: First, to overcome the contraction of the flexor muscles of the legs by the use of the Zander apparatus, and by the use of Zander exercises and by education to get the patient to walk again; secondly, for the removal of the two tumors in the supra-clavicular regions.

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*Read at the Clinical Meeting of the Massachusetts General Hospital, Nov. 9, 1906. Reprinted from the Boston Medical and Surgical Journal, Vol. clv, No. 23, pp. 677, 678, Dec. 6, 1906.

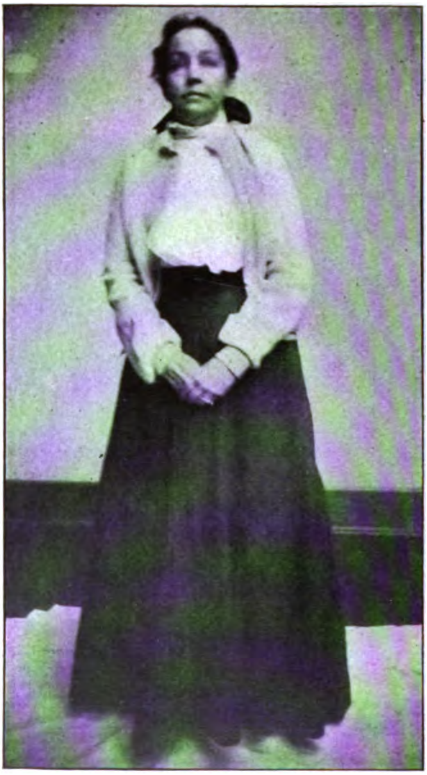

FIG. 2.—Nov. 9, 1906. **Shows patient standing one year after operation.**

The tumors were successfully removed by Dr. Scudder, and were myxo-fibromata.

By the aid of the Zander apparatus the patient had the flexor muscles of the legs stretched by passive exercises, and in time was able to use all the muscles of her legs. She learned to walk first with crutches, and now can walk alone without the aid of crutches or cane.

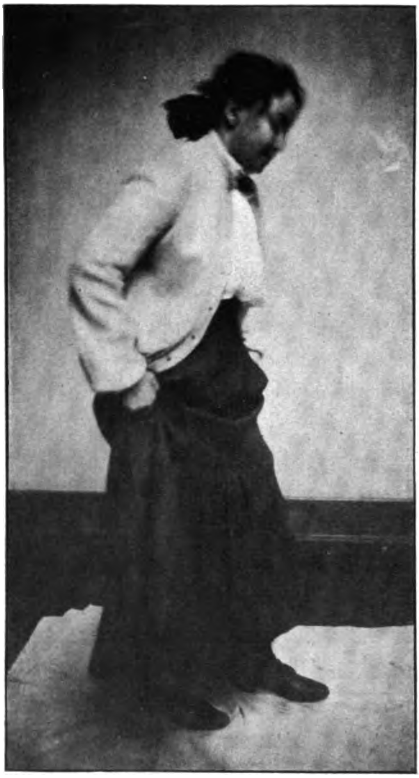

FIG. 3.—Nov. 9, 1906. Shows patient walking.

There is evidence of some degenerative changes in the cord in consequence of the pressure upon it before the operation, but the present state of the patient is far beyond what was expected when the condition of the cord was discovered at the time of the operation.

REPORT OF SURGICAL PROCEDURES.

By Charles L. Scudder, M.D.

In this case of spinal tumor an exploratory laminectomy was done Sept. 19, 1905. It was believed that there was a tumor in the high dorsal region. The removal of the spinous process and laminæ of the fourth, fifth and sixth dorsal vertebræ revealed nothing abnormal. The dura was opened and nothing unusual was discovered. The dura was then sutured and the wound in the soft parts was closed by layer sutures. Care was taken to close the deep fascia securely over the wound left by the removal of the laminæ of the vertebræ. No drainage was used either of the canal or soft parts.

Nov. 7, 1905, a second exploratory laminectomy was done. This time the laminæ of the fourth, fifth and sixth cervical vertebræ were removed. The technique employed in both of these operations was briefly as follows:

The patient rested prone, the chest slightly elevated upon pillows, the head and neck extending beyond the table, the head resting upon an iron frame attached to the end of the table; a long and deep incision was made from the third to the sixth spine, thoroughly exposing with a few strokes of the knife both sides of the spinous processes. Bleeding was checked efficiently by packing the extensive wound with gauze. The bases of the spinous processes, laminæ and the bases of the transverse processes forming the bony floor of the wound were cleared of all muscular attachments most readily by the use of an osteotome or chisel as a lever against the spinous processes, scraping from the base toward the articular processes (Bickham). While one side was thus cleared the opposite side was held packed with gauze.

The spinous processes were removed by bone forceps. The laminæ were divided by a Doyen saw and cutting forceps. The saw should be held slightly obliquely pointing toward the mid-line so as to make the section at right angles with the laminæ. In order to avoid incising the articular processes the saw section should be started very close to the base of the spinous processes, within one quarter inch.

Upon partially dividing the laminæ upon each side the section was completed by the use of bone forceps. These forceps (made by Ford & Co., of New York), devised by Munro, of Boston, are the proper size, strength and shape for the most successful section of the laminæ. Rongeur forceps assisted in completing the exposure of the dura of the cord.

In the present case there was but little bleeding upon opening the spinal canal. This was readily checked by gauze pressure. A small tumor the size of a peach stone was seen lying to the right of the cord and laterally at the level of the fifth cervical vertebra. The cord was held to the left and the tumor removed by blunt dissection. It evidently extended beyond the vertebra laterally into the neck through a tiny opening. At its exit from the canal it was divided. The dura was sutured. The canal was drained by a small rubber tissue wick which was removed in three days. The wound in the soft parts was closed by layer sutures.

The head, neck and shoulders were supported by a plaster of Paris posterior dressing. Recovery from the operation was uneventful.

June 30, 1906, and Sept. 6, 1906, two tumors were removed from the sides of the neck. These tumors had existed some time. Each was the size of a butternut, rounded, slightly lobulated, smooth, elastic and painless. They were situated in the subclavian triangles.

They were found to be deeply seated within the cords of the brachial plexus. The tumor on the left side evidently extended up to the level of the fifth cervical vertebra.

Each tumor was encapsulated and was removed with some difficulty from its deep and intimate connection with the large nerve trunks of the brachial plexus.

These operation wounds healed satisfactorily. Following the removal of these tumors of the brachial plexuses the patient spoke of a little tingling sensation in one hand. This is explained by the manipulation of the nerves in enucleating the growth. This tingling disappeared in a few days.

The gross appearances of the two tumors were alike.

Appended is the pathological report:

PATHOLOGICAL REPORT OF TUMOR OF NECK, REMOVED JUNE 30, 1906.

The specimen consisted of a rounded, irregular tumor 4 cm. in greatest diameter. This was encapsulated and fluctuant. On section it was myxomatous and of a grayish color. The center was occupied by a brownish cystic cavity.

Microscopic examination showed myxomatous fibrous tissue. The cells in most cases were long and oval with small nuclei and indefinite cytoplasm. In other portions the cells were closely packed together. In one section a few nuclei were much larger than the others and somewhat vesicular in character. Diagnosis. Myxofibroma.

(Signed) C. C. SIMMONS, M.D.

PAPILLARY-CYSTADENOMATA OF THE BREAST.

A REPORT ON TWENTY CASES OF THE PAPILLARY CYSTADENOMA TYPE OF FIBRO-EPITHELIAL TUMORS OF THE BREAST.*

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In the Oration in Surgery delivered by Dr. J. Collins Warren at the meeting of the American Medical Association at Portland, Oregon, in July, 1905, a classification of benign breast tumors was presented which was based upon the study of 758 consecutive cases collected and analyzed by the writers of this communication. This classification was offered in the hope that the existing confusion in the nomenclature of tumors of the breast might be done away with.

The difficult point in the classification of benign breast tumors is the association of connective tissue and epithelium in their composition. The breast is a gland structure of epithelial lined ducts supported in a stroma of connective tissue. All tumors having origin in the breast tissue show a participation of both of these elements in varying proportion. In one case perhaps the fibrous tissue predominates, in another the epithelial, but an authentic case of a tumor composed solely of either fibrous tissue or epithelium has not yet been described. It is because of the attempts of different pathologists and clinicians to apply to the tumors of the breast the names accepted for tumors of other organs that such hopeless confusion has resulted, and it was not until Ribbert in his classification of tumors offered a special group of mixed or "fibro-epithelial" tumors that this confusion began to pass away. Ribbert's classification, however, is purely pathological and does not lend itself to the description of the different forms of tumors of the breast as they appear in surgical practice, and the purpose of Dr. Warren's classification is to harmonize the clinical signs and symptoms of those tumors with their pathological nomenclature.

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The first, and perhaps most important, distinction made by Dr. Warren's classification is the separation from the group of tumors of the diffuse processes, giving to the latter the names of (*a*) diffuse hypertrophy and (*b*) abnormal involution. Cases of diffuse hypertrophy have sometimes been confounded with tumors of the periductal fibroma type, and abnormal involution, or cystic disease, has been regarded by many writers as a peculiar form of a new growth, and has been called cystadenoma. Because of its diffuse character, however, this disease cannot properly be regarded as a tumor, although the epithelium shows a tendency to proliferation which in certain respects closely resembles a neoplastic process. The lack of encapsulation, however, and the participation in the process of the whole breast and often of the breast of the other side, seems to warrant its removal from the category of true new growths.

The fibro-epithelial tumors of Ribbert have been divided by Dr. Warren into two groups — the fibrous and the epithelial types (see Table I).

TABLE I.

CLASSIFICATION OF BENIGN BREAST TUMORS. (WARREN.)

I. Fibro-epithelial tumors:
  - (A) Fibrous type
    1. Periductal fibroma.
    2. Periductal myxoma.
    3. Periductal sarcoma.
  - (B) Epithelial type (Cystadenoma)
    1. Fibro-cystadenoma.
    2. Papillary cystadenoma.

II. Hyperplasia:
  - (A) Diffuse hypertrophy.
  - (B) Abnormal involution (cystic disease).

Tumors of the fibrous type in which the fibrous tissue predominates have been called periductal fibroma, periductal myxoma, or periductal sarcoma. They are tumors arising from the peculiar hyaline periductal fibrous tissue of the breast, and they are made up for the most part of this fibrous tissue; although they contain portions of the epithelial gland substance in the form of much distorted ducts and clefts lined with epithelium. The bulk of the tumor is made up of fibrous tissue, and it is classified as periductal fibroma, periductal myxoma, or periductal sarcoma, according to the degree of cellular development and richness in nuclei of this tissue. In these tumors it is obvious that the epithelium participates in the growth only as it is secondarily involved by the increase in amount of the fibrous tissue. They are the firmly encapsulated tumors found in the breasts of young women, may be single or multiple, are freely movable in the breast substance, and have passed under a variety of names, such as fibro-adenoma, chronic mammary tumor, proliferous cyst, adenocele, cystosarcoma phylloides, intracanalicular papillary fibroma, etc.

The epithelial type of fibro-epithelial tumors are those in which the epithelial new growth overshadows the growth of fibrous tissue. In these tumors fibrous tissue is present merely as a stroma to support the epithelial new formation. Tumors of this type, or cystadenomata, are divided into two main classes — fibro-cystadenoma and papillary cystadenoma. The first class, the fibro-cystadenomata, are localized tumors of periductal fibroma origin, in which epithelial proliferation or cyst formation has progressed to such an extent as to overshadow the growth of fibrous tissue. These tumors have been described in the past as cystic fibroma or cystic fibro-adenoma. They are comparatively rare and are of little importance as compared to those of the second group.

Papillary-cystadenomata are not uncommon. They are localized tumors — either single or multiple — and involve, as a rule, the large ducts of the breast. They consist of one or more cysts partially filled with papillary outgrowths, arising from the wall. The papillary growths have a vascular branching connective tissue stalk supporting a luxuriant growth of epithelium in the form of villous projections and glandlike interlacing tubules and canals. The epithelium shows no tendency to infiltrate the surrounding tissues. Tumors of this class have been recognized and described by many writers and under many names: Adenoma, villous papilloma, duct papilloma, duct cancer, cystadenoma intracanaliculare, carcinoma villeux, endocanilicular papillary fibroma, etc.

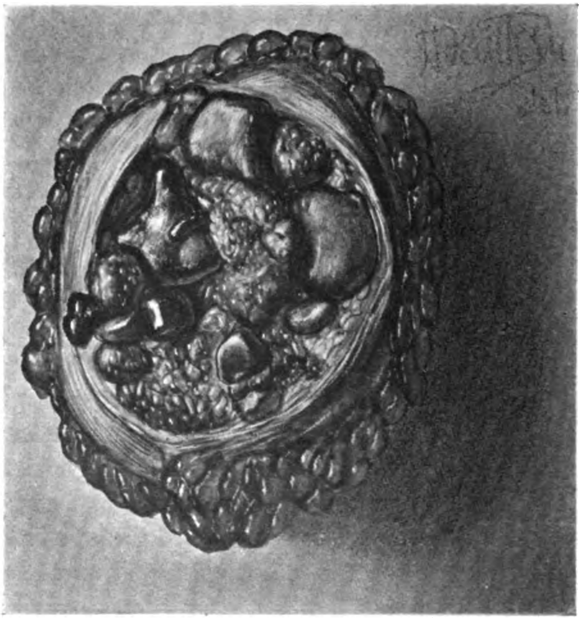

FIG. 1.— Papillary cystadenoma from a girl of 19, removed by an areolar incision. The specimen consisted of a cyst cavity situated directly under the nipple and filled with papillary ingrowths. These varied greatly in size, shape, consistency and color, and the whole could be aptly compared to a gall-bladder full of stones. The color and shape of these ingrowths was due to œdema, hemorrhage and necrosis.

The material upon which this report is based consists of twenty cases of papillary cystadenoma. The specimens were obtained from private practice and at the Massachusetts General Hospital in the services of the following surgeons: Dr. J. C. Warren, Dr. A. T. Cabot, Dr. H. H. A.

Beach, Dr. C. B. Porter, Dr. M. H. Richardson, Dr. J. W. Elliot, Dr. W. M. Conant, Dr. S. J. Mixter, Dr. F. G. Balch, Dr. R. B. Greenough, Dr. C. A. Porter, and Dr. C. L. Scudder, to all of whom the writers would here express their thanks for the privilege of reporting the cases. Much of the pathological material was placed at our disposal by Drs. W. F. Whitney and J. H. Wright, to whom we would also express our gratitude.

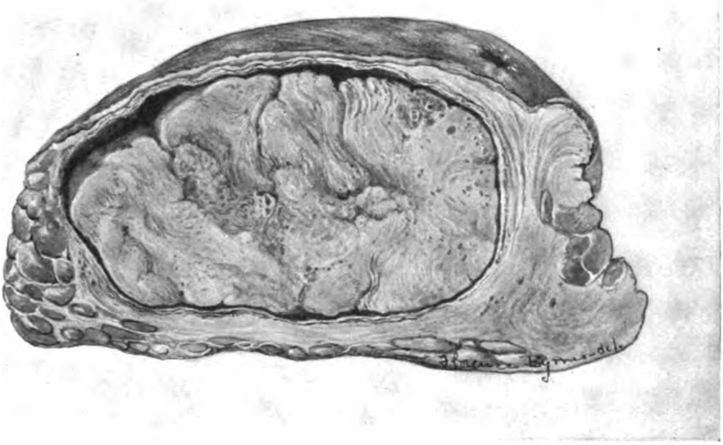

FIG. 2. — Papillary cystadenoma. The cyst was of four years' duration and occurred in a woman 43 years old. It illustrates well the single large type of cyst, the size being due, not to the rapid growth, but to the long duration. There was a small fistulous opening through the skin. The cyst contained a papillary mass of grayish-white friable tissue, which on section was composed of distorted glands and fine fibrous stalks largely necrotic.

Of the twenty cases of papillary cystadenoma three showed the presence of adenocarcinoma. In the other seventeen cases no evidence of malignant disease was to be obtained. A gross and microscopic examination was made of the specimen in nineteen of the twenty cases; in seventeen cases the microscopic specimens, and in many cases the gross specimens also were available for re-examination.

The gross appearances of the seventeen specimens of simple papillary cystadenoma showed the following characteristics: A palpable tumor was present in the breast substance in every case. In twelve instances the tumor was single. In five a number of different nodules were present, forming a conglomerate mass. The tumors varied from the size of a pea to that of an orange. Their situation was almost invariably in the central portion of the breast close to or under the nipple, although the larger cysts extended outward and occasionally occupied almost the entire substance of the gland. In cross-section these tumors presented one or more cysts of varying size containing fluid, which was usually bloody, and filled to a greater or less extent by papillary outgrowths from the wall. The cysts were, as a rule, well marked off from the surrounding breast tissue, and were not adherent to the skin, although in six cases the skin appeared to be closely applied over the tumor and was not freely movable, a fact which was attributable rather to the size of the cyst and its position near the nipple than to any infiltration of the tissue. Retraction of the nipple was noted in the record in three of the seventeen cases of simple papillary tumor and in two of the three cases of adenocarcinoma. It is possible that the development of a benign tumor in the large ducts acts in somewhat the same way as the development of cancer to cause a drag upon the ducts and retraction of the nipple.

The axillary glands were enlarged in only two cases. They did not show malignant involvement even in the cases of carcinoma.

Microscopic sections of the tumors showed one or more cysts. The cysts were as a rule well marked off by a definite layer of fibrous tissue from the surrounding substance of the breast. The breast tissue usually showed evidence of compression by an increase of its fibrous tissue, and occasionally the presence of a small amount of round-cell infiltration. In some cases involution changes were present in the surrounding tissue, which is not surprising when we consider the age of the patients under consideration.

The walls of the cysts were lined with flattened or columnar epithelium which was apparently derived from the larger ducts (Figs. 1 to 6). In one specimen of a tumor of this nature, not in this series, a fortunate section revealed a continuous line of epithelium from the nipple to the wall of the cyst cavity.

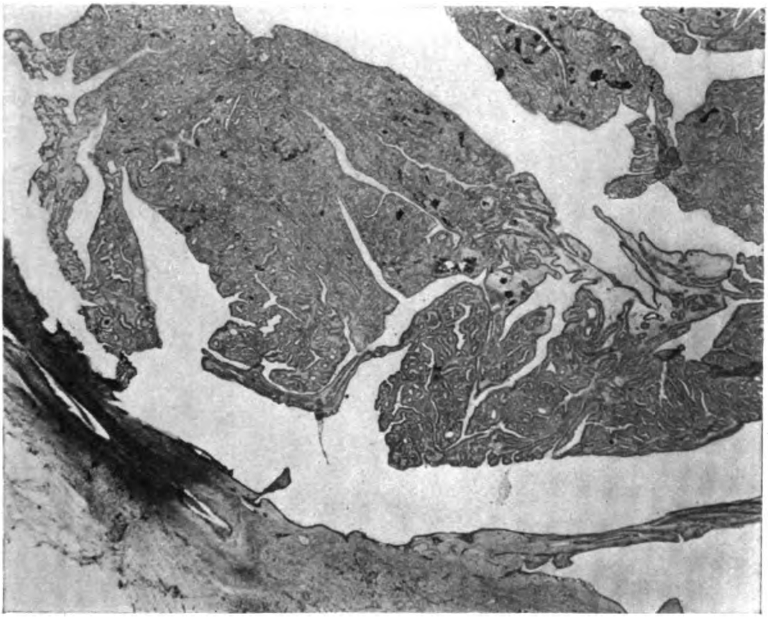

FIG. 3.— Papillary cystadenoma. Section showing the cyst wall and papillary ingrowth. The cyst was lined by a layer of flattened epithelium. The fibrous tissue around this was dense and infiltrated with round cells. The gland ducts in the vicinity were flattened and mechanically disturbed, but otherwise showed little change. The papillary growth completely filled the cyst, which was 2 cm. in diameter. It apparently had several attachments, one of which is seen to the left of the photograph, although this evidently is not the chief one. The appearance of the glands and fibrous tissue is well shown. The dark areas in the papillary growth (suggesting artifacts), are vessels filled with blood. On the right of the drawing (where the glands are not as numerous) the fibrous tissue is œdematous.

The most characteristic feature was the presence of papillary outgrowths from the cyst wall. These papillary growths were composed of a fibrous tissue stroma, with many blood vessels, supporting one or more layers of epithelium continuous with the lining of the cyst. The papillary masses were often divided into many branches and occasionally interlaced in such a way as to present the appearance of a multitude of gland tubules and ducts, lying in a fibrous stroma. The papillæ were often attached to the cyst wall at several points in their circumference. Degenerations of the connective tissue, hemorrhage areas and areas of œdema were not uncommon.

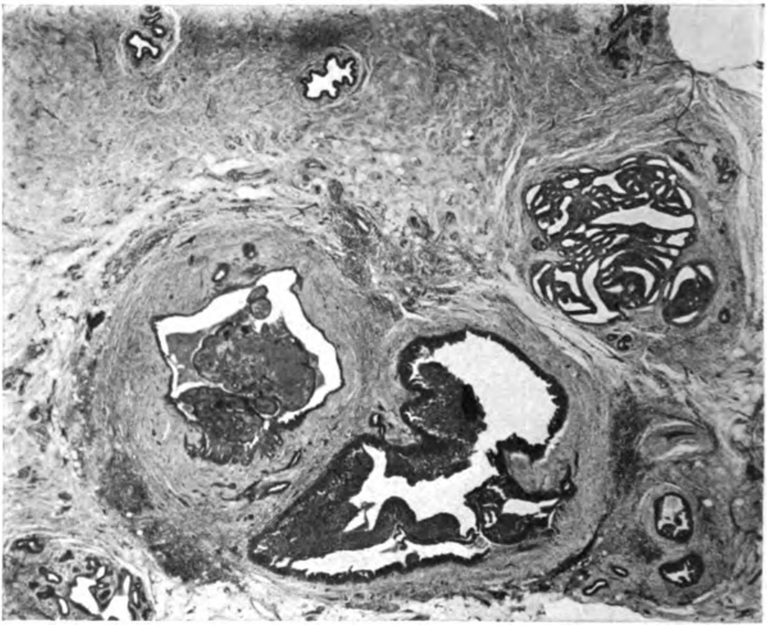

FIG. 4. — Papillary cystadenoma. Small multiple type. These tumors were situated under the nipple and occupied the larger ducts. They were all small, the largest being but ½ cm. in diameter. The papillary projections in the one to the right of the photograph are formed of delicate, branching stalks of fibrous tissue covered with epithelium, the whole forming an irregular mass of somewhat atypical gland ducts. In the cyst in the center of the specimen the epithelial proliferation has been so great as to mask the fibrous tissue, while in that in the left, the fibrous tissue is abundant, somewhat necrotic and œdematous. There is a large amount of interstitial fibrous tissue surrounding the cyst.

The epithelium appeared in many different forms. The lining of the larger cysts was commonly flattened and of several layers. That of the smaller cysts was higher and that covering the papillary outgrowths was often columnar and of different degrees of size and development varying from the familiar narrow cells of the normal ducts, to the high, columnar, well-formed cells seen in the adenomatous proliferation of abnormal involution. So far as anatomical and histological data were available, the origin of the papillary cystadenomata was in the fibrous tissue and epithelium of the walls of the larger ducts.

The degree of proliferation of the epithelium varied in different specimens and even in different portions of the same microscopic section. In one place several layers of flattened cells were found, while in others a single layer of high columnar cells alone was situated against the basement membrane.

The rate of growth of these tumors is very slow, and, as might be expected, the epithelium showed but little evidence of rapid reproduction; mitoses were occasionally seen, but were comparatively rare. Degenerative processes in the papillary masses were not uncommon, and in one specimen particularly, a hyaline degeneration was observed which produced homogenous masses of varying color from red to green and black, which resembled gallstones closely as the papillary growths lay in the opened cyst.

The cyst cavity, in addition to the polypoid tumor masses, contained serous or sanguinolent fluid, apparently from thrombosis or rupture of the vessels of the villous stalks, and in some specimens the wall of the cyst was deeply stained with blood pigment of similar origin.

With regard to the etiology of tumors of this type, very little can be said. Trauma was cited by the patient as the supposed cause of the tumor in five cases. In eight cases no history of trauma could be obtained, and in seven no data on this point were available. So far as age is concerned, the papillary cystadenoma is generally a tumor of old age. The average age of twenty patients was 49.5 years. The extremes, however, cover a large period — the youngest patient being 19 years old and the oldest 81. It is to be noted that no gross or microscopic peculiarities were found to differentiate the tumors of young women from those of older years. The influence of marriage and lactation does not appear to be significant. One of the twenty cases was a male patient of 51 years of age. Of the nineteen women eleven were married and eight had had children. Thus of nineteen cases of papillary tumors there were eight in women whose breasts had undergone lactation, and eleven in those which had not. Whether in developing the polypoid outgrowths from the wall of the duct produce the cyst, or whether the cyst is first produced, and the papillary outgrowth is a secondary process, can only be a matter of speculation.

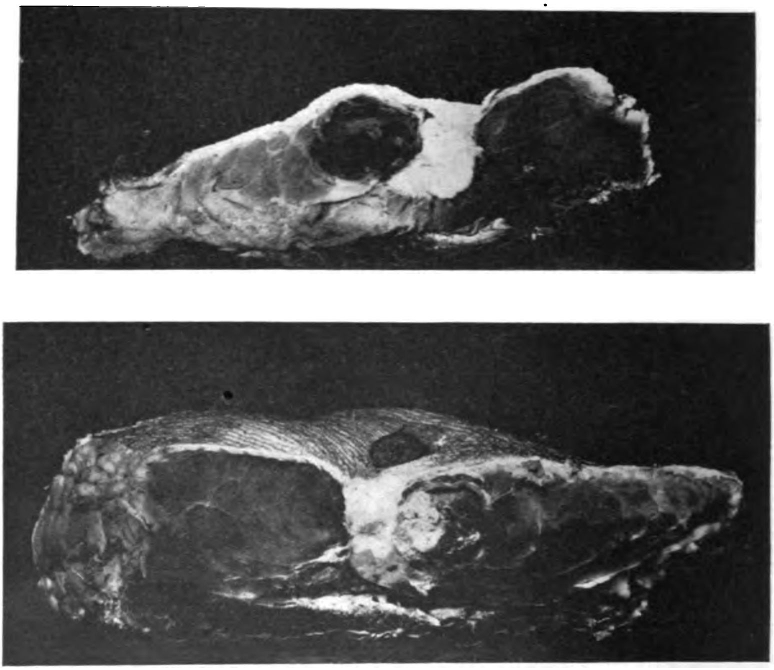

FIG. 5.— Papillary cystadenoma with adenocarcinoma. The upper photograph shows the cyst cavity to the left and the adenocarcinoma (the dense white area) on the right.

In the lower photograph the cyst cavity is seen to the right of the nipple partially filled with papillary ingrowth from the base of which the adenocarcinoma has developed. This is almost directly under the retracted nipple and is adherent to the skin.

The symptoms of papillary cystadenoma are perhaps more characteristic and better defined than those of the majority of tumors of the breast. One or more nodules are found in the central portion of the breast, not far removed from the region of the nipple. These nodules may vary from the size of a pea to that of an orange or larger.

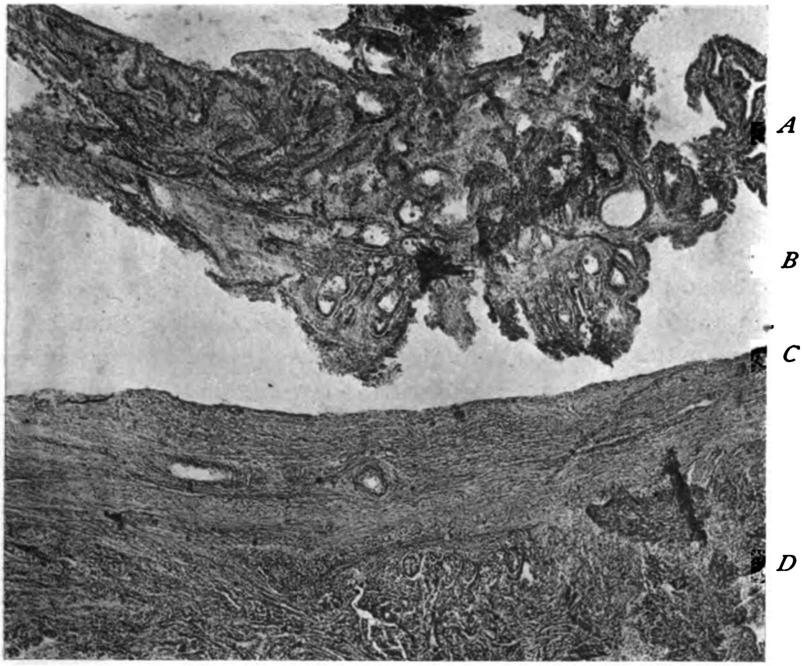

FIG. 6 — Papillary cystadenoma and adenocarcinoma. Section through the wall of papillary cystadenoma. The cyst was situated under the nipple and was 2 cm. in diameter. It was filled with bloody fluid and contained a friable papillary ingrowth. Microscopically at the base of the papillary growth the surrounding tissue was infiltrated by the atypical glands characteristic of adenocarcinoma.

A, Papillary ingrowth.
B, Cyst cavity.
C, Cyst wall.
D, Adenocarcinoma.

They are generally described as hard in consistency, but if not too deep in the breast tissue, and if of sufficient size, an elastic or cystic feeling may be appreciable. One tumor was described as soft, and in a number of cases no tumor at all was felt until some time after the recognition of the bloody discharge from the nipple. The size of the tumors varied in certain of the cases, according to the amount of fluid contained, and could be diminished at will by pressure, forcing the fluid out through the nipple. Pain was present in about one-half of the cases, but was rarely severe, and was not a conspicuous symptom of these tumors, in distinction to the more painful character of abnormal involution.

The symptom which is of the greatest value in the differentiation of papillary from other tumors of the breast is the existence of a serous or bloody discharge from the nipple. This discharge was present in eleven of the twenty cases, while in four of the others the record failed to give information upon the point. It is not to be expected that discharge will always be present, as the escape of the fluid must depend on the patency of the duct between the cyst and the outer world. In one case a fistulous opening was established from the cyst through a sinus which opened at the edge of the areolà, but such a condition is obviously rare.

Tumors of this type are of slow growth. The average duration of the tumor before operation was 25.8 months, the longest being eight years and the shortest one month. It is significant, however, that in three cases at least the discharge from the nipple was present for a long time prior to the discovery of the tumor.

Enlargement of the axillary glands to such an extent as to make them readily palpable is not to be expected. In two of the twenty cases the records state that enlarged glands were felt in the axilla. In the remaining eighteen, including the three cases of carcinoma, no enlarged glands were felt. It is well known that in thin persons, and as a result of irritation, enlargement of the axillary glands sufficient to make them readily palpable is not uncommon. In cases of abnormal involution this frequently occurs. The presence of slightly enlarged glands, however, is of little significance in diagnosis.

The diagnosis of tumors of this character from other tumors of the breast is facilitated by three chief symptoms — *i. e.*, the situation, under or close to the nipple; the slow, painless growth; and the presence of a discharge from the nipple of bloody fluid. As accessory symptoms it should be noted that the skin is not adherent, nor are the axillary glands enlarged.

The conditions with which these tumors are most likely to be confounded are cancer, abnormal involution and periductal tumors. From cancer they are distinguished by their slow growth, definite outline, and by the freedom of skin, muscles, and axillary glands from involvement in the disease. Discharge from the nipple in cancer is very rare.

From abnormal involution the diagnosis is more difficult. Serous discharge from the nipple in such cases is occasionally noted. The diffuse character of this condition, however, and the irregular nodular consistency of the breasts associated with pain and tenderness are points that aid in differentiation. Involution changes also are more common in the periphery of the breast, while papillary tumors occur almost invariably near the nipple.

From periductal fibromata, the diagnosis should not be difficult. The periductal tumors occur, as a rule, at a much younger age. They are firm and elastic, often of large size, and rarely occur near the nipple. They slip and slide in the breast tissue, and never produce discharge. The periductal fibromata are far more likely to be confused with the fibro-cystadenomata (the other type of the cystadenoma or epithelial group), and it is doubtful if the two can be distinguished without the aid of the gross and microscopic examination.

The prognosis of a papillary cystadenoma is uncertain. They are tumors of slow growth and may exist for years without producing serious inconvenience. By the English writers, tumors of this type have been described which in time protruded from the nipple as granular and bleeding polypi. This did not occur in any of these cases. Enlargement to such a size as to cause serious disfigurement did not occur, although one tumor as large as an orange was produced, and a fistulous opening leading to the cyst was already established when the case came under observation. There was no obvious suppuration, but it is to be supposed that infection might readily occur and be followed by necrosis and sloughing of the tumor.

As in all of the tumors of the adult breast, the chief point of interest in prognosis is the likelihood of cancer. In this series of twenty cases, cancer was present in three instances and appeared to be associated with the existence of the papillary tumor, that is, the cancerous nodule was in the wall of the cyst, and the type of growth, adenocarcinoma, was the same in all three cases. Except for the infiltration of the surrounding tissues, the cancerous nodules presented characteristics of growth of the same general character as the papillary structures within the cyst, although the irregular cell growth and infiltration left no doubt about the diagnosis of adenocarcinoma. The occurrence of cancer, however, in 15 per cent. of the cases of papillary cystadenoma is sufficient to warrant the early and complete removal of these tumors, and to justify their classification in a group apart from the periductal type of fibro-epithelial tumors which show no such predisposition to the occurrence of malignant disease.

The duration of the three cancer cases was 9, 12 and 18 months respectively, and their ages were 52, 69 and 76 years. Several of the cases which showed no evidence of malignant disease had been in existence for much longer periods, and in women of equally advanced years. It is perhaps worthy of note that none of the cancer cases showed the familiar symptom of discharge from the nipple, whereas it was present in all of the non-malignant tumors of more than eight months' duration of which we have specific notes. The occurrence of cancer in tumors of this character has been noted by many writers. It is undoubtedly this tendency which has led the English writers to the indiscriminate use of the word "duct-cancer" for papillary tumors of this kind. Tietze and

Sasse have each described cases of this character, under the names of cystadenoma proliferum destruens malignum (Sasse) and adenocarcinoma destruens (Tietze). That a form of adenocarcinoma occurs in certain cases of papillary cystadenoma is supported by this series of cases, but that this is sharply to be differentiated from other forms of adenocarcinoma is perhaps open to question. Of the three cancer cases, two showed no evidence of recurrence at one and two years after amputation of the breast; the third case died of recurrence four years after operation. In only two cases, however, was the axilla dissected, and in these no diseased glands were found. In none of the three cases were the axillary glands palpably enlarged.

From the consideration of the course of development of papillary tumors of the breast it is obvious that radical removal of the tumor is to be advised. As in all other cases of breast tumor also, the frequency of the occurrence of cancer makes an exploratory operation the duty of the surgeon in every case of tumor in which the diagnosis cannot positively be determined to be benign and free from danger of subsequent malignancy; and the number of such cases, with the exception of the small multiple periductal fibromata, is almost nil. When the tumors are large, or multiple, amputation may be necessary to obtain complete removal; but when small and single the breast should certainly be saved. Excision may be performed from the under side of the breast by the "plastic resection" operation advised by Dr. Warren and described in the *Journal of the American Medical Association*, July 15, 1906. In some cases, however, the operation may be simplified, and a small tumor under the nipple readily removed by an incision which follows the lower border of the areola for a quarter or third of its circumference. This incision is carried through the skin alone. With retractors the wound is then drawn open in a direction radiating from the nipple, and the subsequent dissection for the removal of the tumor is carried on by radial incisions in order to avoid injury to the other ducts than the one involved in the tumor. This incision does very little damage to the breast and leaves a scar which is scarcely discernible after a month or two has elapsed.

If microscopic or gross examination of the specimen reveals the presence of carcinoma, it is obvious that a complete operation should be performed. In such a case the pectoral muscles and the axillary contents should be removed, for, although the type of cancer is of relatively low malignancy, the complete operation is only a reasonable precaution. When this is done, the prognosis should be far more favorable than in the average case of cancer of the breast.

Of the seventeen cases of non-malignant tumor in this series, seven had an amputation of the breast, eight had the tumor excised by a plastic or direct incision, and two by the areola incision. In one of the amputation cases the axilla was also dissected. The results of these operations were as follows:

Of the seven amputation cases, one patient could not be traced, five were free from disease at periods of one, one and a half, two, three, and eight years after operation, and one died of old age and debility three years after operation without recurrence.

Of the ten excisions, three were untraced, one showed a local recurrence of the tumor after six months, which has persisted for three and a half years without further increase; another showed a local recurrence eighteen months after operation, which was removed, and the patient has not since reported. The other five cases were examined or reported free from disease at periods of one and a half, three, six, and eighteen months, and four years after operation. Of the two cases of recurrence, one was proved by microscopic examination to be similar to the original tumor and non-malignant, and the other had existed without change for three and a half years, so that the presumption is fair that complete removal of the original tumor was not obtained at the first excision. It is obvious that this should be done in every case, even if amputation is required; but we believe that so radical a procedure is rarely needed.

SUMMARY.

Twenty breast tumors of the papillary cystadenoma type showed the following characteristics:

(1) They were single or multiple, involving the large ducts near the nipple, and composed of one or more cyst cavities from the walls of which grew papillary outgrowths composed of a fibrous tissue stroma and a luxuriant growth of duct epithelium in the form of irregular gland tubules and polypoid projections.

(2) Tumors of this character have been described by many names, viz., adenoma, duct papilloma, duct cancer, villous papilloma, cystadenoma intracanaliculare, proliferous cysts, etc.

(3) They occur in the male breast as well as in the female.

(4) They occur at all adult ages and independent of trauma, marriage or lactation.

(5) They are usually painless.

(6) They are generally situated near to or beneath the nipple.

(7) They are usually of small size, but occasionally attain the dimensions of an orange.

(8) They are of slow growth.

(9) Their most characteristic symptom is the presence of a discharge from the nipple which may be serous, but is usually bloody in character.

(10) Do not cause enlargement of the axillary glands.

(11) Fifteen per cent. of the twenty cases in this series were associated with a form of cancer (adenocarcinoma) of a relatively low type of malignancy.

(12) Treatment demands the complete removal of the tumor, either by excision or, if necessary, amputation of the breast.

(13) Excision may be performed by plastic resection or by an areola incision.

(14) The association of cancer with papillary cystadenoma in 15 per cent. of the cases justifies the separation of this group from other fibro-epithelial tumors of the breast in clinical and pathological classification.

ABSTRACT OF CASES.

I. No. 123. 1896. Dr. J. W. Elliot (ix–180). Female, 57. Married. 1 child. 2 months' duration. Tumor, size of walnut. Right breast. Upper outer quadrant, no pain; discharge not recorded. Excised. Recurrence 2 years later. Same situation. Size of hen's egg. Excised. Both papillary cystadenoma. No later report.

II. No. 11. 1895. Dr. J. C. Warren (320–44). Female, 44. Single. 6 years' duration. Tumor, 2 inches in diameter. Left breast. Upper half. Pain slight. Discharge from nipple for 10 years. Excised. Papillary cystadenoma. No later report.

III. No. 65. 1897. Dr. H. H. A. Beach (325–211). Female, 52. Married, 1 child. 11 years' duration. Tumor, 3 inches in diameter, under nipple. No pain. Discharge not recorded. Excised. Papillary cystadenoma. No further report.

IV. No. 15. 1895. Dr. A. T. Cabot (334–70). Female, 61. Single. 9 months' duration. Tumor, size of orange. Left breast, under nipple. No pain. Discharge not recorded. Amputation. Papillary cystadenoma. 1906, reports no further trouble.

V. No. 91. 1900. Dr. H. H. A. Beach (339–2). Female, 57. Widow. 2 miscarriages. 1 month's duration. Tumor, size of hazel-nut, under nipple. Pain slight. Discharge serous for 10 years. Bloody in last 12 months. Excision. Papillary cystadenoma. No later report.

VI. No. 217. 1901. Dr. J. C. Warren. Female, 81. Single. Tumor, size 3 cm., near nipple. Slight pain. No discharge. Amputation. Papillary cystadenoma. Died 3½ years later of old age and debility. No trouble with breast.

VII. No. 166. 1902. Dr. A. T. Cabot (li–220). Female, 42. Married. 6 children, 1 miscarriage. Normal lactation. 1½ years' duration. Tumor, size almond, under nipple. Slight pain. Discharge brownish and bloody for 3 years. Excision. Papillary cystadenoma. Tumor recurred in same situation and has persisted for 4 years. No further operation.

VIII. No. 171. 1902. Dr. W. M. Conant (lix–14). Female, 45. Married, 8 children; 2 miscarriages. Breast abscess on other side 2 years ago. 6 months' duration. Tumor under nipple. No pain. Discharge bloody on pressure. Excised. Papillary cystadenoma. Report, 4 years later, no trouble.

IX. No. 184. 1903. Dr. W. M. Conant (lxxxi–295). Female, 35. Married, 8 children. 1 year's duration. Tumor size of chestnut, under nipple. No pain. Bloody discharge. Amputation. Examination, 4 years later. No trouble.

X. No. 204. 1904. Dr. S. J. Mixter (469–145). Female, 67. Married, children (?) Duration, 2 years. Tumor, size of egg, near nipple. No pain. Discharge not recorded. Amputation. Papillary cystadenoma. Reports, 3 years later, no trouble.

XI. No. 210. 1905. Dr. C. A. Porter. Female, 43. Married. 4 children. 4 years' duration. Tumor, size of small orange, near nipple. Sinus at edge of areola. Painful of late. Discharge from sinus watery and bloody. Amputation. Papillary cystadenoma. Report, 18 months, no trouble.

XII. No. 209. 1905. Dr. R. B. Greenough (42–352). Female, 19. Single. 1½ years' duration. Tumor, size of half a hen's egg. No pain. Bloody discharge from nipple. Excision by areola incision. Papillary cystadenoma. 19 months later, examination, no further trouble.

XIII. No. 211. 1905. Dr. Wm. M. Conant. Male, 51. 4 months' duration. Tumor size of walnut. Upper outer quadrant. Pain not marked. Bloody discharge from nipple on pressure. Amputation with dissection of axilla. Papillary cystadenoma. Examination, 16 months later, no trouble.

XIV. No. 205. 1906. Dr. S. J. Mixter. Female, 24. Single. 4 years' duration. Tumor size of lemon, under nipple. Slight pain at time of catamenia. Discharge from nipple bloody and purulent (?) Excision. Papillary cystadenoma. No later report.

XV. No. 206. 1906. Dr. J. C. Warren. Female, 34. Married, no children. 8 years' duration. Tumor, size of walnut. Right breast; lower inner quadrant. No pain. Discharge not noted. Plastic resection. Periductal fibroma and papillary cystadenoma. 6 months later, result perfect.

XVI. No. 208. 1906. Dr. F. G. Balch. Female, 30. Single, 4 months' duration. Tumor, size of walnut, under nipple. Considerable pain. No discharge. Excision with areola incision. Papillary cystadenoma. Result, 3 months later, perfect.

XVII. No 212. 1906. Dr. C. L. Scudder. Female, 40. Single. 7 years' duration. No pain. Bloody and serous discharge. Plastic resection. Papillary cystadenoma. No later report.

XVIII. No. 216. 1898. Dr. S. J. Mixter (333-177). Female, 52. Married, no children. 9 months' duration. Tumor, 2 inches in diameter, near nipple. Pain slight. Discharge not recorded. Nipple retracted. Skin adherent. No glands felt in axilla.

Amputation. Papillary cystadenoma and adenocarcinoma. Died four days later of cancer of the breast.

XIX. No. 215. 1901. Dr. H. H. A. Beach (385-136). Female, 76. Widow, 2 children. 1 year's duration. Tumor, size of walnut; upper inner quadrant. No pain; non-adherent. No gland felt in axilla. Amputation. Axilla not dissected. Papillary cystadenoma and adenocarcinoma. Report, 1 year later, no recurrence.

XX. No. 214. 1905. Dr. J. C. Warren. Female, 69. Single. 18 months' duration. Tumor, size of walnut, under nipple. Adherent to skin. No glands felt in axilla. Slight pain. No discharge. Complete amputation. Axilla not dissected. Papillary cystadenoma and adenocarcinoma. 2 years later, examination showed no recurrence.

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A DEMONSTRATION OF THE SPIROCHÆTA PALLIDA OF SYPHILIS, WITH DESCRIPTION OF RAPID METHOD OF STAINING.*

By T. J. Manahan, M.D., *of Boston.*

From Pathological Library, Massachusetts General Hospital.

In May, 1905, Schaudinn and Hoffman presented their work on the occurrence of a spiral-shaped organism in syphilitic lesions. This organism they named the *Spirochæta pallida.* Their observations were confirmed by Metschinkoff one month later. Since then a great many confirmatory observations have been made by others in this country and abroad. The evidence is conclusive that primary lesions, condyloma, macular, papular, pustular lesions and mucous patches contain the *Spirochæta pallida* either constantly or in the majority of cases. Schaudinn has demonstrated it in aspirated splenic juice taken from a case of recently acquired syphilis. Rickzet and Noeggerath have found it in the blood, while several others have failed. The pallida has been found in the skin of congenital syphilitic children. A most interesting case was one of Flexner's, who found the organism in skin lesion of a child whose mother acquired syphilis five years before. Metschinkoff and Flexner have found the *Spirochæta pallida* in monkeys which have been successfully inoculated with syphilis.

The *Spirochæta pallida* measures 4 to 10 microns long and ½ micron wide. The curves are short, corkscrew-like and vary in number from 4 to 20. The organism is motile, rotating on its long axis, and has sharpened ends. Flagella have been observed. I have observed a forking at the end in one specimen. Other spirilla occur about the healthy genitals and in non-specific ulcerations. The form seen most frequently is the *Spirochæta refringins.* This organism is broader, has longer and fewer curves and stains more intensely than the pallida. There is no difficulty in differentiating them after one has made many observations. In a recent paper, Schaudinn and Hoffman state that it is their conviction that the *Spirochæta pallida* is the definite cause of syphilis. Metschinkoff expresses confidence and thinks syphilis is a chronic spirilla infection.

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The first specimens I examined were stained by the Geimsa method, which is the one first recommended by Schaudinn and Hoffman. This method requires eighteen hours and stains the *Spirochæta pallida* very faintly. On experimenting with Dr. Wright's blood stain I found the organism could be much more intensely stained in a period of five minutes with this stain. This rapid and more intense method of staining is a great advance, as it saves time and makes the recognition of the organism comparatively easy. The application of Wright's blood stain to the staining of smears obtained from syphilitic lesions is as follows: The stain is prepared according to the directions given in Mallory and Wright's "Pathological Technique," p. 371.

Five-tenths of a gram of the dried methylene blue eosin precipitate is added to 100 cc. of pure methyl alcohol, Merck's guaranteed reagent, and after a concentrated solution is obtained, the solution is filtered. Take 30 cc. of the filtrate and add 10 cc. of pure methyl alcohol.

This solution is now ready for use and should be kept in a tightly corked bottle to prevent evaporation. If evaporation takes place, a precipitate will form which will so obscure the specimen as to prevent the recognition of the organism.

The film is covered drop by drop with as much of the staining fluid as the coverglass can conveniently hold and allowed to remain one minute. Water is then added, drop by drop, until a metallic film appears on the surface. In my experience I have found that four drops give the best results. The stain is now kept on for five minutes and then washed in water. The amount of water used should be just enough to remove the staining fluid. On examination, the red corpuscles should be a pale blue and the *Spirochæta pallida* purple. If the differentiation is carried any further with water, the *Spirochæta* do not stain as deeply. The coverglass is dried over the flame and mounted in balsam. Preparations should be made with great care in order to prepare thin and evenly distributed smears. The method of obtaining the material depends on the seat and character of the lesions.

In chancres, where ulceration has taken place, the following method has been found most suitable: The lesion is washed with water and gauze removing as much of the necrotic tissue as possible. At the junction of the ulcerated area with the indurated margin a small incision, 4 mm. long and 2 mm. deep, is made with a tenotome. The first few drops of blood are removed with gauze and the bleeding checked by pressure. Then with the back edge of the tenotome a small amount of material from the bottom and sides of the wound is removed. This material, which will be blood-tinged serum, is then placed on a ⅞ coverglass, which has been carefully washed in absolute alcohol and ether and a smear made in the same manner as you would prepare a blood smear. In mucous patches two methods are employed to obtain the material. The selection of the method to be used depends upon the character of the lesion. In fissures of the tongue or mucous patches which have gone on to ulceration, the lesion is washed with gauze and water. The necrotic material is then removed with a small, blunt curette. After the bleeding has stopped, the base of the fissure or ulcer is gently scraped with the curette. The material thus obtained is placed on a coverglass and a smear made. In early mucous patches before ulceration takes place, the procedure is as follows: The edge of the diseased mucous membrane is lifted with a tenotome and from the wound a drop or two of the blood-tinged serum is placed on a coverglass and a smear is made.

Preparations from the skin eruptions may be made by one of the two following methods:

A bleb is made by the application of strong ammonia over the skin lesion. When a bleb is formed, remove the serum with a platinum loop and make a smear. This method has not been satisfactory. Another and more satisfactory way is to scrub the skin thoroughly with alcohol and water. Then select a well-developed macule or papule and scrape off the upper layers of skin with a knife until a bloody serum exudes. A good-sized drop of bloody serum is allowed to form. Remove this drop by touching it with the surface of a coverglass. The drop will adhere to the coverglass and a smear is then made.

Through the kindness of Drs. J. T. Bowen, C. J. White, D. F. Jones and H. Cabot, I was able to obtain material from eighteen cases. These cases were from the Skin, Surgical and Genito-Urinary Out-Patient Departments of the Massachusetts General Hospital.

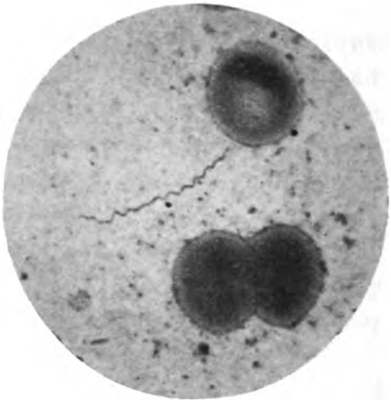

Photo by Mr. L. S. Brown.

Case I. — From chancre, five weeks' duration, showing Spirochæta pallida of syphilis and red blood corpuscles. x 1500.

Case I. Male; age, thirty-two. Ulcer appeared on penis three weeks after coitus. At present time, five weeks from appearance of sore, there is an ulcer on the corona 1 cm. in diameter with indurated edges. There is a macular papular eruption on the chest, back, abdomen and arms, and also a mucous patch on the lower anterior gum. (See plate.)

The clinical diagnosis was syphilis.

Coverglasses were taken from the ulcer, and showed several spirochæta pallidæ. The examination of the mucous patch showed many spirochæta pallida, there being about three times as many as seen in the smear from the penis. The smears from the skin and blood were negative.

Case II. Male; age, seventeen years. Gonorrhea for two weeks. Twenty-three days after coitus a small sore appeared on the penis. Four weeks later a fine papular eruption on the chest, back and arms. The diagnosis of syphilis was made at this time. Eleven weeks later I examined smears taken from the skin. At this time the eruption was fading. I examined ten smears, all of which were negative, likewise smears from the blood.

Case III. Male; age, eighteen. Eight weeks ago primary lesion on penis, followed five weeks later by a macular eruption on body and arms, and is still present. The clinical diagnosis of syphilis was made on the day the smears were examined, and the case up to this time had no anti-specific treatment. I made smears from a young papule, and found a few spirochæta pallida. The blood smears were negative.

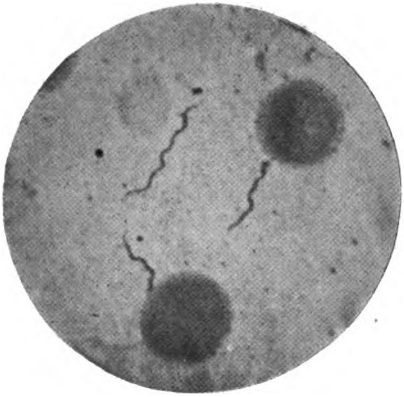

Photo by Mr. L. S. Brown.

CASE 5.— From ulcer of penis showing Spirochæta refringins and red blood corpuscles. x 1500.

Case IV. Male; age, twenty-four. Three weeks ago sore came on penis two weeks after coitus. On the under side of the frenum is a hard ulcerated area. The epitrochlear, inguinal, and post-occipital glands are enlarged, and there is an eruption on the chest and arms. Clinical diagnosis, syphilis. Smears from ulcer showed several spirochæta pallidæ, while smears from the skin macule and the blood were negative.

Case V. Male; age, twenty-six. Urethral discharge for two weeks. Examination shows uretheral discharge with multiple indurated ulcers about the prepuce. Inguinal glands enlarged, but not tender. Smears made from the ulcers failed to show any of the spirochæta pallida. Many smears were examined in two lots. The second smears were taken four days after the first examination. Later the patient developed a phimosis, and was circumcised. Following the operation the local condition improved rapidly, and was discharged well five weeks later, with no evidence of syphilis. (See plate.)

Case VI. Male; age, twenty-eight. Has had gonorrhœa for three months. Ten days ago a sore came on penis following coitus three weeks previous. Six weeks later characteristic eruption appeared. The diagnosis of syphilis was made, and the patient placed under treatment. The treatment has been constant, and the only lesions now are two mucous patches. Smears from the mucous patches showed many spirochæta pallidæ.

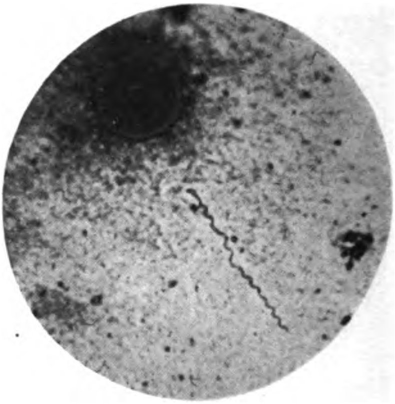

Photo by Mr. L. S. Brown.

CASE 10. — From mucous patch six days' duration showing Spirochæta pallida of syphilis and red blood corpuscles. x 1500.

Case VII. Male; age, twenty-one. Two months ago developed gonorrhœa and an ulcer on the penis. One month ago throat and mouth became sore, and at this time he noticed a faint skin eruption. At present he has several mucous patches and anal condylomata. Clinical diagnosis, syphilis. Smears from mucous patches showed many spirochæta pallidæ.

Case VIII. Male; infant, three months old. Two weeks ago skin eruption appeared. The child is thin, anemic, and poorly nourished. Examination shows a general macular eruption on body, with papular eruption on palms and soles of feet. Abdomen enlarged. Clinical diagnosis, congenital syphilis. Examination of smears from skin lesions were negative. In this case I examined twenty slides taken from arms, body and legs.

Case IX. Female; age, twenty. Ten days ago a small sore appeared on the middle of the lower lip. Since then it has increased in size, and is now 8 mm. in diameter. It is an indurated, somewhat elevated ulcer. Under the angle of the left jaw is a hard, tender swelling the size of a large marble. Clinical diagnosis, ulcer of lip with septic gland. Smears were taken from the ulcer, and were negative, although many slides were examined. One week later a second examination was negative.

Case X. Female; age, twenty-three. Fourteen months ago was treated in the Out-Patient Department for multiple chancroids. Examination at that time showed the bacillus of Ducrey. Five days ago she came again to the hospital with an ulcer on the upper lip which is in the median line, covered with a scab with a fissure in the center. Examination showed the post-occipital glands enlarged on each side. The pharynx is red and there are patches on the anterior pillars. Three weeks ago had a sore on the finger which has since healed. Complains of severe headaches, general pains. She has been married one year, and two months ago gave birth to a child which is now said to be dying from consumption. Thus far I have been unable to obtain the child for observation and material. Clinical diagnosis, syphilis.

Examination of smears from the lip showed many spirochæta pallidæ. (See plate.)

In this case the diagnosis was doubtful clinically. The value of a quick method of staining the spirochæta pallida was well demonstrated in this case as a diagnostic measure.

Case XI. Female; age, forty-two. Has been under treatment for syphilis for the past year. At times she has neglected carrying out the treatment. Eighteen months ago a gummatous nodule appeared on the upper anterior surface of the tongue. At the present time it is still present as an elevated hard area about the size of a quarter. Clinical diagnosis, gumma of tongue. Microscopic examination of smears from the surface and center of the gumma failed to show any spirochæta pallida.

Case XII. Male; age, twenty-three. Sore throat for three weeks. Macular papular eruption on forearm and palms. Remains of induration on prepuce. Enlarged epitrochlear glands. Tonsils enlarged. Several sloughing mucous patches. Clinical diagnosis, syphilis. Smears taken from mucous patches show many spirochæta pallidæ.

Case XIII. Male; age, twenty-four. Has had a sore on the upper middle surface of penis 14 mm. in diameter, slightly indurated. The center is covered with necrotic granulation tissue, the edge is clean cut. There is an eruption on the body suggesting scabies. Clinical diagnosis, scabies, and diagnosis of ulcer deferred. Several smears were examined for the spirochæta pallida, but all were negative.

Case XIV. Female; age, twenty-three. Three months ago red pimples appeared on a portion of the interior aspect lower part of right leg. They enlarged in size and ulcerated, and were followed by others of the same description. Otherwise well. Gives no venereal history. Clinical diagnosis, ulcers of leg. Smears were taken from the ulcers and showed many bacteria, but no spirochæta pallidæ.

Case XV. Male; age, twenty-five. Ten months ago sore on penis six weeks after last coitus, disappeared with cauterization. No rash. Three months ago three small sores on scrotum. Five days ago shifting pains followed by a lumpy petechial eruption, more or less over the entire body. Gums and tongue swollen. Physical examination: Glands in neck and groin. Penis gangrenous. Line of demarkation formed 8 cm. from pubes. The clinical diagnosis in this case is doubtful. The patient had a severe general infection, but is now recovering under anti-specific treatment. Smears from granulating wound of penis were negative.

Case XVI. Male; age, twenty. Has had trouble with penis for two weeks. Typical induration. Area on prepuce with porky roll. No ulceration. No other objective symptom. The patient does not speak English, and it was not possible to obtain an accurate history. Clinical diagnosis, syphilis (?) Several smears were taken from sclerosed area and no spirochæta were found.

Case XVII. Male; age, twenty-eight. Sore on penis seven weeks ago coming on three weeks after coitus. At present time an indurated area on under side of corona with a granulating patch in the center. There is a generalized macular eruption over chest and back. The inguinal, post-occipital and epitrochlear glands are enlarged. There are mucous patches in the mouth. Clinical diagnosis, syphilis. Microscopic examination of smears shows several spirochæta pallidæ in ulcer of penis, and many more in the mucous patches.

Case XVIII. Female; age, twenty-three. Has large swelling on upper lip, which started four months ago like a cold sore. Picked it with a pin and it began to swell. Has not been painful. It is not as large now as it was three months ago, and has been decreasing in size daily. The under surface of the tongue is furrowed and has patches. The lesion on the lip is 1.5 cm. in diameter, hard, and is covered by thin mucous membrane. Vaginal examination: Hymen intact. Condylomata on vulva. Clinical diagnosis, syphilis. Primary lesion of lip. Smears from lip and tongue lesions show many spirochæta pallida.

Summarizing the observations made in these cases, I found the presence or absence of the *Spirochæta pallidæ* to be as follows:

		Spirochæta	Pallida.
		Present.	Absent.
Clinical Diagnosis Syphilis	Chancres,	4 cases	1 case
	Mucous,	6 ,,	0 cases
	Skin lesions,	2 ,,	3 ,,
	Blood,	0 ,,	4 ,,
	Gumma of tongue,	0 ,,	1 case
Clinical Diagnosis, Lesion of Non-Syphilitic Origin or Doubtful		0 cases	6 cases

It is evident from these facts that the *Spirochæta pallida* was present in the first group of cases constantly in the chancres and mucous patches. In these cases the clinical diagnosis of syphilis was clear. In the chancre, where I failed to find the organism, the sore had completely healed. The failure to find them in the blood in view of the observations of others, is undoubtedly due to faulty technique on my part. In the six cases of the second group the clinical diagnosis were doubtful or other than syphilis. In these cases careful searching failed to show the *Spirochæta pallida*, although the *Spirochæta refringins* was frequently seen.

Conclusion. — From my observations I believe that the constant occurrence of the *Spirochæta pallida* in typical syphilitic lesions indicates, first, that it is the organism which causes syphilis.

Second, that by method of staining which I have described in ulcers of the penis, an early diagnosis can be made without waiting for the appearance of secondary symptoms. This is a great advantage, because the treatment can be commenced before a general systemic infection has taken place.

Third, that the presençe of large numbers of *Spirochæta pallidæ* (in one case fifteen in one field) in mucous patches bears out well the known clinical fact as to the infectiousness of mucous patches.

DESCRIPTION OF PLATES.

The first and third microphotographs shown in the accompanying plates show two *Spirochæta pallidæ*, one from a chancre and the other from a mucous patch where syphilis was acquired over one year before.

The second plate shows the *Spirochæta refringins*. The excursion of the curves are longer and fewer in number than in the pallida. It can also be seen that the diameter of the refringins is slightly greater.

PRIMARY TUMORS OF THE URINARY BLADDER.

A STUDY OF FORTY-ONE CASES AT THE MASSACHUSETTS GENERAL HOSPITAL.*

By Lincoln Davis, M.D., *of Boston.*

Out-Patient Surgeon, Massachusetts General Hospital; Instructor in Anatomy, Harvard Medical School.

The cases which form the basis of this paper are taken from the clinical records of the Massachusetts General Hospital since 1877, and the autopsy records since 1897. There are included in this series of forty-one cases only primary tumors of the bladder which have been verified by either operation or autopsy. Many cases in which the diagnosis was made by the presence of villous fragments in the urine, or from the clinical symptoms, or by the cystoscope, but which for various reasons did not come either to operation or autopsy, are not included. Neither are numerous cases of malignant disease of the bladder, obviously secondary to cancer of the uterus, prostate, or intestines, included.

The object of this study has been:

First. To record such clinical data, as the analysis of a considerable number of cases affords, with special reference to end results after operation.

Second. To investigate the pathological anatomy of the simple epithelial tumors of the bladder, commonly called papillomata, with relation to the ultimate prognosis.

To this purpose the hospital records have been carefully analyzed, and after persistent search, reliable information as to the histories of patients after discharge from the hospital have been pretty generally obtained; personal interviews were possible in a few cases. All the pathological specimens which were preserved have been reëxamined, and studied in relation to each other, and to the clinical course of the disease.

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* For the privilege of reporting these cases I wish to acknowledge the courtesy of the Visiting Staff of Surgeons of the Hospital. I also desire to thank Dr. W. F. Whitney, Surgical Pathologist, and Dr. J. H. Wright, Director of the Clinico-Pathological Laboratory, for the use of their valuable material and for kind assistance. Reprinted from Annals of Surgery, April, 1906.

In thirty-seven of the forty-one cases included in this report, the tumors were removed by operation; in the remaining four cases the condition was found at autopsy. A summary of the cases in the form of a table follows at the end of this article.

ETIOLOGY.

Prevalence. — The fact that in the twenty-eight years since 1877 only thirty-seven cases of primary tumors of the bladder have been operated upon at this hospital, leads one to believe that the disease is a comparatively rare one, at least in this locality.

It is interesting to note that in the same period of time there have been four hundred and forty-two cases of stone in the bladder operated upon. This comparison, however, is not strictly fair, for it is reasonable to suppose that a greater number of cases of tumor than of stone have been overlooked, since the diagnosis of the former condition was, until the perfection of the cystoscope within recent years, rather uncertain, while a perfectly adequate method of diagnosticating stone has been known for years. Then, too, doubtless in the earlier years, on account of the greater formidableness of the operation for tumor as compared to that for stone, some of the former cases, even if diagnosticated, may not have been attacked.

By decades the cases of tumor group themselves as follows: 1877–1887, 5 cases operated on; 1887–1897, 14 cases operated on; 1897–1905, 18 cases operated on. The increase since 1897 is not striking, considering the improved methods of diagnosis and operative technique.

That the disease is generally considered a rare one is shown by the much-quoted figures of Küster, who found 10 cases out of a total of 3938 cases of tumors of all kinds operated upon at the Augusta Hospital in Berlin, ¼ of 1 per cent. Gurlt collected 66 cases out of 16,637 cases of tumors in three large hospitals in Vienna, less than 0.4 per cent.

Albarran, on the other hand, maintains that tumors of the bladder are far from rare, and cites the fact that in Guyon's ward at Necker in 4 years there were 55 vesical tumors, or 3.9 per cent. of all genito-urinary cases there treated.

Sex. — In this series of cases there were 7 females and 34 males, an excess of males slightly less than that reported in other collections of cases. Albarran's figures are 14 per cent. of females in 381 cases. Nitze's figures show a still smaller percentage of females.

Age. — The age at which the patients entered the hospital with the disease has been noted. In decades the cases group themselves as follows: Under 20 years, 1 case; 20–30, 2 cases; 30–40, 2 cases; 40–50, 5 cases; 50–60, 21 cases; 60–70, 7 cases; 70–80, 8 cases. This shows a marked preponderance of cases in the sixth decade, a fact generally noted. The youngest patient was 16 years old, a case of sarcoma; the oldest 73. The average age was 53.

Excluding two comparatively rare forms, myxoma and sarcoma, which occur in childhood, the first exclusively and the second commonly, tumors of the bladder in general, although occurring throughout adult life may be said to essentially belong to the period of middle life, and early old age.

Cause. — The direct cause of tumors of the bladder as of tumors elsewhere in the body is not known. The frequency with which certain cell inclusions have been found in the epithelial tumors of the bladder, has led to considerable discussion of the parasitic theory in connection with their origin.

According to the weight of best authority, however, these cell inclusions can be adequately explained as the products of either cell activity or degeneration, as the case may be, and the parasite remains to be actually demonstrated.

Of predisposing causes several have been advanced from time to time and seem to have more or less weight.

Chief of these is irritation (chemical, mechanical or bacterial).

That chemical irritation of the bladder has some relation to the formation of bladder tumors seems to be borne out by the prevalence of this condition among workers in aniline factories. A striking number of such cases have been reported by Rehn, Leichtenstern and Huldschiner. It cannot be doubted, it seems to me, that there is here something more than mere coincidence. That it is more than a contributing factor, however, cannot be claimed in view of the small proportion of cases to which it applies relative to the total number of bladder tumors.

In this series of cases chemical irritation of the bladder seemed to play no part in the causation of the disease, so far as an investigation of the occupations of the patients could determine this point. The occupations were various, and diverse, including all the ordinary vocations of life; sea-faring men, of whom there were five, were for some unaccountable reason in the majority.

The mechanical irritation of stone in the bladder has been considered an etiological factor of importance. Rosenow has collected from the literature 44 cases in which stone was associated with tumor. From a study of the clinical history and post-mortem findings of these cases, he reasons that the stone was primary in 18 cases, and the tumor in 8. He concludes "that contrary to the views of Neelsen, Busse, and others, an etiological relationship between calculus and tumor is not to be denied altogether, and calculus seems to favor the development of tumor in a larger percentage of cases than tumor favors the development of stone."

The latter part of this conclusion is not only contrary to the views of the authors quoted above, but is at variance with the opinions of such authorities as Guyon, Albarran and Nitze. The former says that it can be affirmed that preceding diseases of that organ (the bladder) or of the urethra, such as gonorrhœa, stricture, cystitis, stone, retention, hypertrophy of the prostate predispose to tumors of the bladder in no way. Nitze makes a statement to the same effect.

Furthermore, there is considerable evidence that tumor does favor the development of stone in many cases, the secondary changes in the bladder which inevitably sooner or later result from the presence of a tumor, such as inflammation, ulceration, retention, etc., furnishing the very conditions which are most favorable for the formation of a calculus.

The well-known frequency of calcareous incrustation of tumors is evidence of this tendency. It is merely a further step in the same process to the formation of a true calculus about a detached fragment of tumor, and such cases have been reported.

An investigation of cases in this hospital with reference to the association of stone and tumor may be of interest. It is a striking fact that of the 438 individuals who underwent 492 operations for stone in the bladder since 1872, only one (Case XVIII) according to the records, subsequently developed a tumor of the bladder. If others did so the condition was either unrecognized, or treated elsewhere. Among this number there were many cases of recurrent vesical calculi with repeated operations, which were doubtless subjected to the "irritation of stone" in no small degree. It must in fairness be said, however, that in a number of these cases of recurrent vesical calculi there was enlargement of the prostate gland, and that in at least one of them, possibly more, it was afterwards discovered that the gland was carcinomatous. Such cases not being primary tumors of the bladder, are not included in this series, but are mentioned as possibly throwing some light on the difference of opinion which exists as to the association of stone and tumor.

Of the 41 cases of primary tumors of the bladder, in addition to Case XVIII, already mentioned, there were 7 cases in which there was an association either past or present with true calculus or deposition of urinary salts.

These cases, Nos. I, IV, XV, XVIII, XXIII, XXIX, XXXI and XXXVI, may be briefly summarized as follows:

Case I.—A villous tumor of the bladder incrusted with urinary salts was removed by Dr. Warren. No history of previous stone. Death 14 years later. Cause of death recorded in Massachusetts Archives as "renal calculi."

Case IV.—Service of Dr. Bigelow. Urinary symptoms for 8 months, with hæmaturia for 2 months. At operation a lithotrite was introduced into the bladder and what seemed to be a soft stone seized and crushed. The evacuator brought out some fragments of stone with blood-clots. A vaginal cystotomy was then done, and a tumor the size of two English walnuts removed from the bladder. The patient died at the end of 7 days.

Case XV.—This case has been reported in detail by Dr. A. T. Cabot.[1] A brief résumé follows here:

In 1870, in another city, the patient was cut for stone by the lateral perineal route. Frequency of micturition persisted ever after this. In 1884 there was a sharp attack of cystitis, and five years later fragments of stone were passed. In September, 1889, the patient entered the hospital; the bladder was searched for stone, washed out with the Bigelow evacuator, and several small fragments composed of papillary masses of epithelial cells mixed with urinary salts came away. Suprapubic cystotomy was then performed by Dr. Cabot, and a thick, flat, cutaneous-looking sheet of tissue removed from surface of bladder,—"Pachydermia vesicæ."

In March, 1892, the patient began to have pain in the bladder and frequent micturition again. In July, 1894, he reëntered the hospital with a discharging sinus above the pubes. The sinus was enlarged by Dr. Cabot and the interior of the bladder explored: it was found invaded by a new growth. A small portion which was removed proved to be epidermoid cancer. The patient died a short while later, and at autopsy the bladder, as well as the kidneys, muscles of abdominal wall and retroperitoneal glands, were found to be involved in the disease.

Case XVIII.—This case also has been reported by Cabot.[2] There was a history of stricture of the urethra, for which no operation was done. Six years later, after an attack of renal colic (?), a few small, pea-sized stones were passed. Eight years later, symptoms of cystitis developed, which steadily increased for a year, until a small stone in the bladder was crushed by Dr.

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[1] Papers on Genito-Urinary Surgery. "A case of cystitis with formation of a thick epidermal sheet in the bladder,— Pachydermia vesicæ."

[2] Papers on Genito-Urinary Surgery. "Observations upon stone in the bladder."

Cabot in 1895. In the course of a few months there were two recurrences of stone, for which there was no apparent cause, as the bladder emptied itself and the urine was acid. In November, 1895, the bladder was opened above the pubes by Dr. Cabot; a stone was removed from the postprostatic pouch, and a little myoma with ulcerated, granulating surface, incrusted with urinary salts was removed. There was no recurrence of symptoms for 2 years. History after this time not known.

Case XXIII. — Service of Dr. Elliot. Symptoms of cystitis with hæmaturia following confinement 2 years before. Passed several small stones during the preceding year. In May, 1900, the urethra was dilated and two small tumors removed from bladder. In December of the same year she reëntered the hospital with the same symptoms, and a history of having passed blood and some stones. A suprapubic cystotomy was done by Dr. Greenough. A deposit of calcareous matter was curetted off the bladder wall, and two papillomatous masses removed. No history subsequent to the discharge from the hospital could be obtained.

Case XXIX. — Hæmaturia of 3 months' duration. Papillary tumor incrusted with urinary salts removed by suprapubic cystotomy by Dr. Cabot. No urinary symptoms 2 years later.

Case XXXI. — Operation 31 years ago at the age of 9 for stone in the bladder. No urinary symptoms from that time until the beginning of the present trouble, 3½ years ago, when he first noticed bloody urine which has persisted intermittently since. In February, 1904, a papillary tumor of the bladder was removed by Dr. Cabot. No stone. In August of the same year he returned to the hospital with recurrence of symptoms. The bladder was reopened by Dr. Conant and found studded with nodular growths, which were curetted out and cauterized. He left the hospital somewhat relieved. Death from the disease ensued 2 months later.

Case XXXVI. — A large fibro-myo-sarcoma removed by Dr. Balch, the lower portion of the growth was incrusted with urinary salts.

Of these 8 cases there were 4 (Cases I, IV, XXIX and XXXVI) in which there was not true stone formation, but incrustation of existing tumors with urinary salts. In these it is evident that the tumor was the primary factor.

In 2 cases (Nos. XVIII and XXIII) it is not possible to determine which was the primary etiological factor. In Case XVIII, the probability of the early stones having favored the development of the tumor, a myoma, is at least offset by the contrary evidence that the late ones were the result of it. Case XXIII is inconclusive through incompleteness of subsequent history.

Two cases (Nos. XV and XXXI) in which the stone was unquestionably primary in point of time, remain to be considered. Case XV was complicated by the rare condition of pachydermia vesicæ, which is of notoriously slow development, and therefore very likely may have antedated both conditions, the persistence of the bladder-symptoms after removal of the stone giving color to this view. Be that as it may, there are at least as good grounds for attributing the tumor, which was epidermoid cancer in this case, to a malignant transformation of the leukoplakia, as to the direct result of a single stone removed 24 years previously.

Hallé, who reported 7 personal cases of leukoplakia of the bladder, in 1896, advanced the theory of the malignant degeneration of this condition. He supported his theory on the evidence of one of his own cases, in which the coexistent lesions of leukoplakia and cancroid were found, and also on the analogy of a similar tendency in leukoplakia of the mouth.

Of Hallé's 7 cases it is interesting to note that 4 were associated with stone; in 3 of these the stone was evidently secondary in origin, in the fourth case this point could not be determined.

In the other case (No. XXXI), there can be no question but that the calculus was primary, the interval of 26 years, however, between the removal of the stone and the onset of tumor symptoms, — an interval characterized by the entire absence of all bladder symptoms, — makes it hard to believe that "irritation" played an important part in the causation of the tumor.

Among these cases should be mentioned for the sake of completeness 2 cases (Nos. XXXII and XXXVIII) in which the patients gave a history of having passed gravel, respectively, 1 and 2 years previous to entrance to the hospital. In neither of these cases was stone or deposition of urinary salts found in the bladder. The unconfirmed observation of a patient as to the passing of gravel is liable to too many sources of error to be accepted without scepticism, and therefore it seems not worth while to consider these 2 cases further.

As far then as an analysis of these cases goes, it may at least be said that no strength is added thereby to the irritation-of-stone theory.

Under the head of mechanical irritation should be mentioned the effects of the distoma hæmatobium. The occasional association of papilloma, carcinoma and sarcoma with Bilharzia disease of the bladder has been reported by Goebel. Zuckerhandl, in his "Handbuch der Urologie," pictures very beautifully a "Bilharzia papillom" showing numerous calcified distoma embryos in the stroma of the tumor. This source of irritation, like the aniline poisoning, is of great interest, but is necessarily restricted to a very limited field and lies outside the scope of this paper.

Bacterial irritation of the bladder, as in cystitis, enlarged prostate, etc., may be dismissed as of no real importance in the causation of bladder-tumors, except possibly in the rare instances of epidermoid cancer. In only a small proportion of cases in this series was there any history of urinary disturbance antedating the symptoms which could be properly ascribed to the tumor itself.

Early gonorrhœa had been present in 6 cases. No sequelæ of that disease were mentioned in the histories except in one case, where stricture of the urethra had been present 15 years previous to the tumor.

In 16 cases it was stated that there never had been gonorrhœa. In 19 cases there were no data as to this point.

Symptoms of cystitis, — that is, frequent and painful urination, — were the first complaints in 15 cases, but the cardinal symptom of tumor, hæmaturia, followed shortly in all; the only exceptions being Case XVII in which there was a period of 5 years characterized by frequency of micturition and scalding before the onset of hæmaturia; Case XVIII, a myoma, in which hæmaturia was never noted; and Case XL, in which there had been recurrent attacks of pain in the left kidney region for 20 years preceding the occurrence of blood in the urine.

The cases in which there was a previous history of stone have already been detailed.

In the remaining 20 cases hæmaturia was the first urinary symptom noted.

PATHOLOGY.

In 28 of the total of 41 cases, microscopical examinations of the tumors removed were recorded. According to these reports there were 15 cases of cancer, 10 of papilloma, 2 of sarcoma, and 1 of myoma. Under the first heading were included such varieties as infiltrating cancer, epithelioma, villous and papillary carcinoma, adeno-carcinoma, mesothelial cancer, and epidermoid cancer. Under the heading "Papilloma" were included 4 cases designated as malignant papilloma, one case as probably malignant, and 2 cases in which the question of malignancy could not be determined from the specimen. Of the 2 sarcomata, one was a round-cell variety, the other a fibro-myo-sarcoma. There were 3 cases in which secondary operations were done for recurrent tumors; in one case the recurrent growth was reported to be of the same nature as the original, — viz., cancer; in another a papillary cancer was reported to have recurred as a papilloma, and in a third an epithelioma as a carcinoma.

To the multiplicity of terms employed by different investigators with regard to the epithelial tumors of the bladder, are to be attributed seeming discrepancies, which are more apparent than real, but which are nevertheless confusing.

How shall a malignant papilloma be distinguished from a papillary cancer, or an epithelioma from a papilloma, or carcinoma?

Recourse to the literature does not dispel this confusion, as a most varied nomenclature and classification of these growths has been adopted by different authorities. With the hope of clearing away the confusion on this subject in my own mind at least, a careful study has been made of the pathological specimens which had been preserved in 19 cases, and were kindly placed at my disposal.

Classification. — It seemed necessary at the outset to adopt a classification for these tumors. That proposed by Küster, based on histological structure, dividing tumors of the bladder into 3 groups according to the 3 elements of the bladder-wall, — epithelial, connective tissue, or muscular, — from which their principal elements are derived, is the simplest and perhaps the most generally accepted. This has been followed with one radical change in interpretation for which there is good authority, namely, the transposition of the papilloma (Zottenpolyp of Küster) from group 2 to group 1. With this change the classification stands as follows:

1. Epithelial group	papilloma carcinoma adenoma cysts
2. Connective-tissue group	sarcoma myxoma fibroma angioma
3. Muscle group	myoma

This is essentially the classification of Albarran reduced to its simplest terms. It does not include certain rare forms of bladder tumors such as rhabdo-myoma, chondroma, and dermoids, which are not derived from any normal elements of the bladder-wall, and for which Albarran makes another class under the name "Heterotopic." As none of these rare forms was observed they are mentioned only to be dismissed from further consideration.

Papilloma. — The term "papilloma" has been retained in this classification, objections on the score of ambiguity of the word being outweighed by the sanction of long usage in English medical literature. The term as here used refers to a pedunculated papillary or villous tumor consisting of a branching connective-tissue stalk, containing blood-vessels and occasionally smooth muscle-fibres, covered with one or more layers of epithelial cells, but without epithelial infiltration of the bladder-wall. This tumor is classed under the first or epithelial group, as the epithelial element in it is regarded as the essential one. There are, however, great variations in the proportions of epithelium and connective tissue in different specimens. All gradations occur from the tumor in which the connective tissue forms a thick and massive stalk with but a thin covering of two or three layers of epithelial cells, a form which is hardly to be differentiated from the pure fibroma, to that in which the connective tissue is reduced to a mere line threading its way brokenly between masses of epithelial cells packed in countless layers.

Yet in the main, two types of papilloma stand out as fairly distinct, the villous and the lobulated. The villous type, "fimbriated papilloma" of Sir Henry Thompson, is characterized by the delicacy and tenuity of its connective-tissue processes, which spring like a tuft of grass from a circumscribed base. The structure of the tumor is so delicate that it collapses into a soft mass when exposed to the air, and it is only when observed in a fluid medium that its slender filamentous nature is appreciated. Microscopically, the epithelial covering is usually comparatively thin, comprising but a few layers of cylindrical cells. By some observers this variety is regarded as merely an early stage in the development of the second type, the lobulated papilloma, "fibro-papilloma," of Thompson. In the lobulated papilloma the connective-tissue stalk is thicker and more branching, and the epithelial covering also, as a rule, considerably thicker, so that the tumor has a firmer consistency and retains its shape when removed, resembling closely a miniature cauliflower.

There may also be marked divergence from the normal type on the part of the epithelial cells in these tumors, as to size, shape and arrangement, so that some of these papillomata may present most atypical or malignant aspects, so-called transitional forms, which are only to be differentiated from the true carcinoma by the absence of epithelial invasion of the bladder-wall.

There being then such variations in the structure of this form of tumor, it is but natural that there should have been much confusion as to its terminology and classification. The terms, "fungus" of early authors, "zottenkrebs" of Rokitansky, "fibroma papillare" of Virchow, "papillary epithelioma" of Zeigler, "zottenpolyp" of Küster, "fimbriated" and "fibro-papilloma" of Thompson, and "villous tumor" of many writers, all refer to this same growth, and illustrate well enough the different points of view from which it has been regarded. Nitze, though retaining the term papilloma, follows Virchow and Küster in classifying it as a connective-tissue tumor.

Carcinoma. — There is corresponding confusion on the subject of primary carcinoma of the bladder, particularly in regard to that form commonly called papillary or villous carcinoma, which is generally conceded to be the most prevalent variety. There has been and still is great divergence of opinion among authorities as to what constitutes a papillary carcinoma of the bladder. Rokitansky held that all papillary epithelial tumors of the bladder were malignant, and designated them as zottenkrebs. This view is still held to a certain extent. Virchow was the first to emphasize the fact that benign "papillary fibromas" did occur. The existence of benign epithelial tumors of the bladder has been amply confirmed since.

Albarran distinguishes two forms of epithelial tumors of the bladder according to the type of their epithelial coverings, — the benign papillomata, or (as he prefers to call them) "polyps bénins," and the malignant epitheliomata. If the type of the normal epithelial cells of the bladder is reproduced, then the tumor is a papilloma; if the cells are, on the other hand, atypical, then the growth is an epithelioma.

Other authorities, notably Orth and Ziegler, make epithelial infiltration of the bladder-wall, and the formation of metastases, the distinctive sign of a carcinoma in this locality as elsewhere.

The fact, which is pretty generally recognized, that a benign papilloma may undergo carcinomatous degeneration, makes it evident that there must be a stage in this process when it will be exceedingly difficult, if not impossible, to determine whether a growth is benign or malignant; the term "transitional" has been applied in such cases. This tendency of papillomata to malignant degeneration will be considered in more detail later.

It is also a generally conceded fact that of two tumors which are otherwise macroscopically and microscopically indistinguishable, the bladder-wall may show epithelial infiltration in one, and not in the other.

Under these circumstances it seems requisite for the sake of clearness and uniformity in differentiating these papillary growths, that the condition of the underlying bladder-wall in regard to epithelial infiltration should be made the crucial test of malignancy, rather than the character and arrangement of the cells in the growth itself. The former criterion is definite and precise, and even if its application is not possible in all cases of operative removal of the tumors, is, nevertheless, to be preferred to one which, although possessing a wider range of application, is so indefinite and subtle, and subject to such latitude of personal interpretation, as to surely lead to differences of opinion.

Other forms of carcinoma, such as the diffuse or nodular infiltrating growths, are distinctive and offer no difficulties in recognition.

Relative Frequency of Papilloma and Carcinoma.— As the result of differences of definition among authorities, there are widely divergent views as to the relative frequency of papilloma and carcinoma.

Albarran may be quoted as an exponent of the view that malignant growths greatly predominate. He records 81 epithelial tumors of the bladder which were histologically studied by himself. Of these, 13 in which the epithelium was considered typical, were classed as papillomata, and 68 in which it was atypical, were classed as epitheliomata, without reference to the question of infiltration of the bladder-wall. The word epithelioma is here used, according to the custom in France, as indicative of malignancy.

Nitze, who upholds the contrary view, mentions 220 cases of his own which were anatomically studied. Of these 144 were papillomata, 64 carcinomata, 2 adenomata, 7 sarcomata, and 5 myxomata.

Küster was the first to point out a source of error which doubtless led many observers to consider as malignant, papillary tumors which were really benign. This was the appearance of masses of epithelial cells surrounded by a connective-tissue framework which might give at first the impression of alveolar carcinoma, but which a closer study, especially of serial sections, revealed as folds between the papillary processes, cut in such a manner as to produce this effect. Another source of error which has been pointed out by Colley is the possibility of fragments of epithelial cells broken from the delicate villi of the tumor in the process of preparing the section, becoming transposed to other portions of the section, where they may be regarded as evidences of metastases. I have frequently observed little clumps of epithelial cells scattered about the edges of the tumor, at the base, as well as on the surface, which I have regarded as due to this cause.

With this preliminary clearing of the path, we may proceed to a consideration of the cases in hand.

Analysis of Cases. — Specimens were personally examined in 19 cases; of these 17 belonged to the epithelial group, with which this analysis is particularly concerned.

In 6 of these 17 cases there was satisfactory evidence, either microscopial or macroscopical or both, of epithelial invasion of the bladder-wall. These cases were, therefore, regarded as carcinomata.

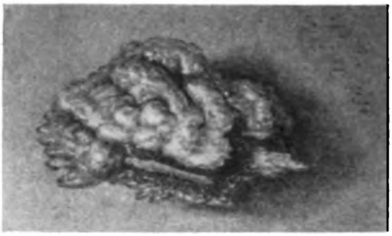

Fig. 1. — Lobulated papilloma natural size (Case XXXV).

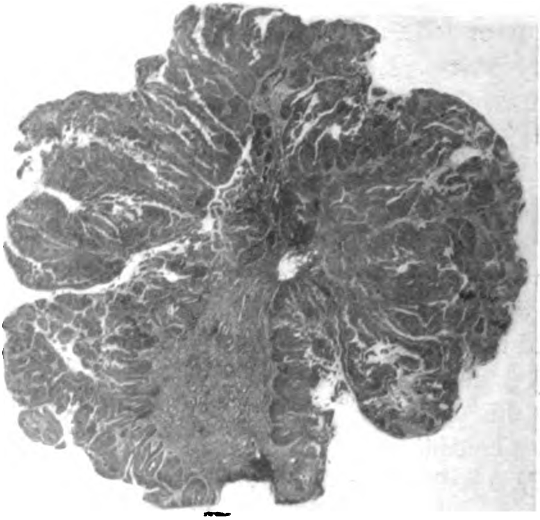

Fig. 2. — Section of a lobulated papilloma x 4 diameters (Case XXXVII).

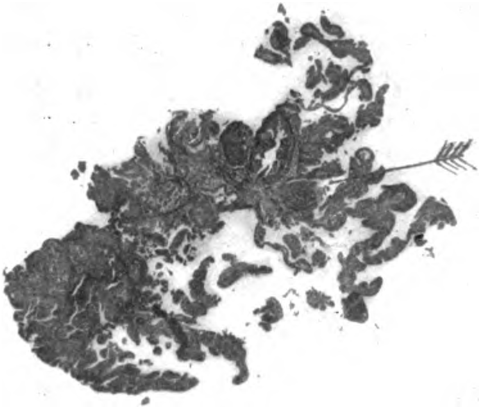

FIG. 4. — Section of lobulated papilloma x 5 diameters (Case XXI). This was a recurrent growth removed 8 years ago, with no subsequent recurrence.

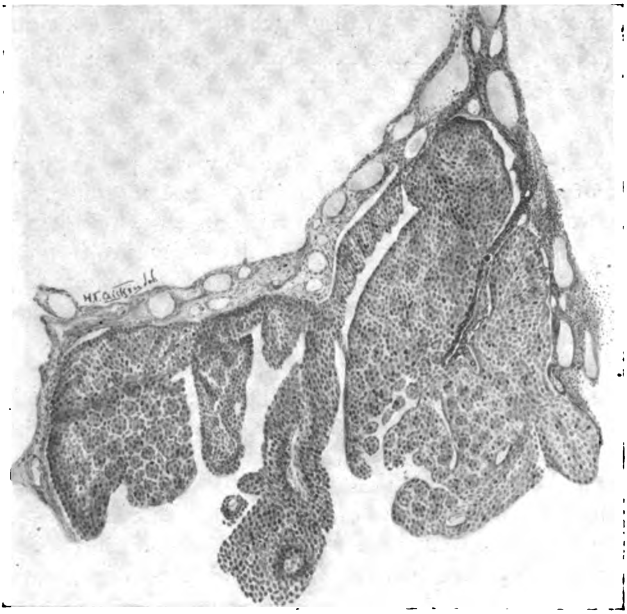

FIG. 5. — Low-power drawing of detail of same at point marked by arrow. Shows vascularity of connective-tissue stalk, and comparative thickness of epithelial covering, which has been drawn on one side of the stalk only. The concentric arrangement of the epithelial cells in small clusters is quite striking.

In 7 cases the specimens allowed of a more or less complete examination of the underlying bladder-wall, which was found to be free from epithelial infiltration. These cases were, therefore, regarded as papillomata.

In the 4 remaining cases the specimen did not contain any portion of the bladder-wall, so that the question of epithelial infiltration could not be determined by the microscope in them. Neither was there macroscopical evidence of infiltration at the time of operation. These cases must be considered doubtful, then, as far as this test goes. It is in such cases that the structure of the tumor itself, and particularly the type and arrangement of the epithelial cells, offer a clue of more or less value as to the benign or malignant nature of the growths. On these grounds, which have already been characterized as unsatisfactory, these 4 cases have been tentatively classed among the papillomata.

Cases of Papilloma.—The specimens in the 4 doubtful cases (Nos. XX, XXI, XXVI, XXXV) may be briefly described as follows:

Case XX.—The specimen in this case was a papillary growth the size of a chestnut, which on section showed a pedicle, without bladder-wall, from which sprung a rather coarse, branching, vascular, connective-tissue framework, markedly infiltrated with round cells and covered by a many-layered epithelium of fairly regular type, and not excessive thickness. The line of demarcation between epithelium and connective-tissue was fairly sharp. No mitoses were observed.

Case XXI.—The specimen, one of two similar ones removed, consisted of a papillary growth of about the same size as the preceding one, showing none of the bladder-wall. The branching connective-tissue stroma was slight and exceedingly vascular. The epithelial covering was of considerable thickness in places, and here and there were clusters of epithelial cells in a concentric arrangement forming epithelial whorls. Line of demarcation not everywhere sharp; no mitoses. (See Figs. 4 and 5.)

Case XXVI.—The section was of a papillary growth, somewhat larger than the two preceding, showing a number of branching stalks springing separately from a common base, composed of connective tissue without muscle-fibres. The papillary processes consisted of a central branching stalk of connective tissue of some thickness, containing blood-vessels clothed with a many-layered epithelium which, for the most part, did not greatly exceed in thickness the width of the stalk. The epithelial cells were of large size and quite uniform, cylindrical at the base, becoming cuboidal at the surface, disposed in layers, 12 to 30 in number, approximately. They presented a regular and typical arrangement. Mitoses were, however, strikingly numerous. The line of demarcation between epithelium and connective tissue was particularly clear cut. There was some small cell infiltration of connective tissue of base and a number of plasma cells. (Figs. 6 and 7.)

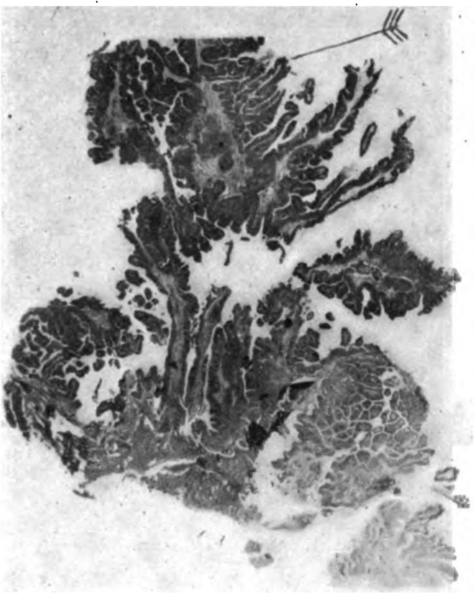

FIG. 6. — Section of papillary epithelial tumor x 5 diameters (Case XXVI). In this case there was recurrence with death from the disease.

Case XXXV. — Sections consisted of fragments of a papillary tumor the size of a pigeon's egg (Fig. 1), showing neither base nor bladder-wall. The delicate connective-tissue stroma was covered with a many-layered epithelium of very considerable thickness. The cells were of fairly large size and were so closely packed together in places as to partially obliterate the spaces between neighboring papillary processes. Occasional mitoses were observed. The line of demarcation between epithelium and connective tissue was sharp.

In the sections of all these cases there were masses of epithelial cells entirely surrounded by a connective-tissue stroma; these are all, however, susceptible of Küster's explanation. In Cases XX and XXVI there were small clumps of epithelial cells scattered about the edges of the specimens, at the base as well as at the surface; these were considered to be the result of trauma to the specimen after its removal.

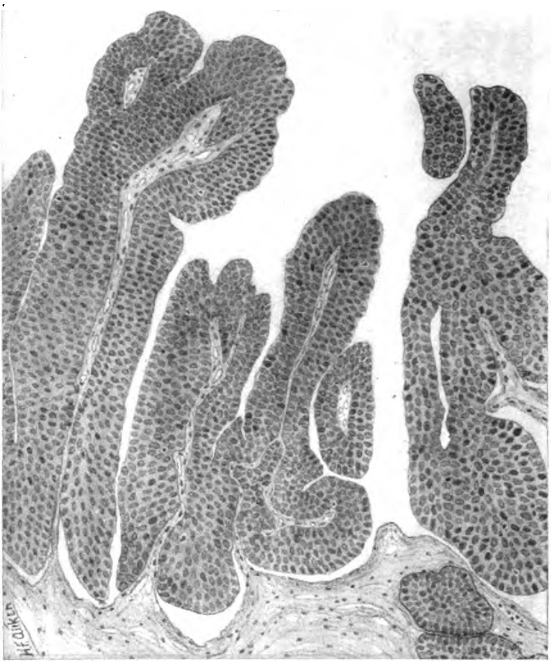

Fig. 7. — Low-power drawing of detail of same at point marked by arrow, showing regularity of epithelium and sharp line of demarcation between it and connective-tissue stroma. The mitoses which were strikingly numerous are not shown.

It would surely be difficult to draw accurate differential conclusions as to their benign or malignant character from the histology of these specimens. Of the four, No. XXVI, except for the number of mitoses, showed the most typical epithelium.

What light does the clinical history of these cases after operation throw on the question of malignancy ?

In Case XX, eighteen months after the operation, death resulted from another disease without recurrence of bladder symptoms. In Case XXI, there have been no signs of a recurrence in the 8 years which have elapsed since the operation. In case XXVI, there was a recurrence and a second operation, 18 months after the first, with death from the disease 2 months later. The histology of the recurrent growth will be considered under another heading. In Case XXXV, there were no bladder symptoms for 4 months after operation.*

Clinically then, one case (No. XXI) seems to have been proved benign. Another (Case XX) also probably benign. Two cases have recurred. In No. XXVI, which will be further considered, the recurrence was proved to be malignant, in the other (No. XXXV) it is also probably malignant.

In 4 cases (Nos. XXIX, XXX, XXXIII, and XXXVII) the specimens removed contained portions of the bladder-wall including muscularis; careful examination of these failed to reveal evidences of epithelial infiltration in any. These specimens were of a similar nature to those already described; the first 3 of them, however, showed a greater proliferation of epithelium and a less typical arrangement, in fact a more malignant aspect, than any in the first group.

Case XXIX. — A papillomatous tumor the size of the end of a finger was removed from the bladder with the cautery, including a margin of healthy mucous membrane and a considerable extent of bladder-wall, including the muscularis. The tumor was incrusted with urinary salts. Doubtless owing in part to the escharotic effect of the cautery, and also on account of the necessary removal of the incrusted portions, the specimen was rather imperfect and confusing. A main stalk of considerable thickness could be made out, from which there were very fine lateral offshoots, covered with an extremely thick layer of epithelium. The epithelial cells were quite variable in size and shape, and showed in places a very irregular or atypical arrangement. There were occasional mitoses. The line of demarcation was not everywhere sharp between the epithelium and connective tissue of the stalk. There was marked round-cell infiltration of the stalk. The bladder-wall itself showed no epithelial infiltration.

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* This patient reëntered the hospital Feb. 5, 1906, with history of slight hæmaturia for 4 months. I did a suprapubic cystotomy and removed the prostate which was regarded as suspicious of malignant disease; there was no sign of a recurrence of the papilloma. Microscopical examination of the prostate showed simple hypertrophy. The patient made a good recovery from this operation, but 4 months later hæmaturia recurred. Cystoscopy at this time showed the bladder wall to be studded with small papillomata, and by rectal palpation the bladder floor seemed indurated. Operation was refused. The patient is still living (May, 1907), in comparative comfort, with only occasional hæmaturia.

Case XXX. — Section of a papillary growth 2 x 3 cm., with a portion of the base and muscularis of bladder-wall; there were a number of long, slender connective-tissue stalks covered with an exceedingly thick layer of epithelial cells. The villous processes in places were fused. The arrangement of the epithelial cells varied considerably in different parts of the growth, being in places quite typical, in others quite atypical. A number of mitoses were observed. The line of demarcation was not sharp; no epithelial infiltration of bladder-wall. There was an opportunity to examine the bladder two days later at autopsy in this case. A partial prostatectomy for adenoma of the prostate had been done at the same time that the papilloma was removed. The bladder was found to contain much clotted blood, with hemorrhagic infiltration of the tissues about the bladder. On the mucosa of the posterior bladder-wall there was a small shaggy mass with a short pedicle. The bladder-wall at the site of removal of papilloma showed some thickening. Microscopic examination, however, according to the autopsy report, showed no evidence of carcinoma. This section could not afterwards be positively identified. The section of the small papilloma, found at autopsy, showed a papillary excrescence not larger than a pea, which was partly denuded of epithelium. The epithelium where it existed was disposed in few layers. Lying on the connective-tissue stroma just below the surface and in places communicating with the surface, were clumps of epithelial cells, some of which contained open spaces in the center, giving to them a glandular appearance. There was no epithelial infiltration of the bladder-wall at the base of the tumor. The section corresponded closely to what Zuckerkandl has described and pictured as cystic papilloma.

Case XXXIII. — The specimen consisted of a pedunculated growth, 6 cm. in greatest diameter, which was removed from the bladder together with a considerable extent of underlying bladder-wall, including its muscularis. Microscopically, the growth consisted of a number of long, slender stalks which were extremely vascular, radiating outwards from a circumscribed pedicle. These stalks were clothed with an epithelial covering of great thickness which consisted of large epithelial cells, varying considerably in size and arrangement.

In places the cells were packed together very closely, neighboring villi becoming fused and the papillary structure lost. In other places the arrangement was quite typical. Mitoses were rare. Line of demarcation between epithelium and connective-tissue fairly sharp. There were evidences of intense inflammation of the bladder-wall, with round-cell infiltration. Absolutely no epithelial infiltration. The specimen is very like that in Case XXX.

Case XXXVII. — In this case two tumors were removed from the bladder, one the size of a pigeon's egg on the right margin of the trigonum, and another smaller growth, size of a large pea, on the posterior wall above trigonum.

The larger section showed a papillary tumor with its pedicle but without bladder-wall. (Fig. 2.) The stalk was comparatively coarse and contained muscle-fibres. The epithelium, less thick than in many of the preceding specimens, was composed of small, strikingly uniform, cylindrical cells, sharply marked off from the connective-tissue stroma. No mitoses were observed. The smaller specimen was of the same character, showing a good portion of the bladder-wall without infiltration. Serial sections were made of both these specimens, but beyond demonstrating the fact that masses of epithelial cells, apparently enclosed in a connective-tissue stroma really were a part of the surface epithelium, showed nothing.

Clinically, in Case XXIX, there is perfect health 2 years and 2 months later. Case XXX has no clinical after-history; the histological evidence of benignity of the growth, is, however, quite complete.

In Case XXXIII there is perfect health one year later. Case XXXVII is too recent to be considered.

It would be premature to draw conclusions from these histories, but it may be said, as yet, the histological findings have not been belied by the clinical data.

In 3 cases (Nos. XXXVIII, XXXIX, XLI) the specimens were obtained at autopsy, and cut together with a portion of the bladder-wall to which they were attached. In these cases an excellent opportunity was afforded to examine the whole thickness of the bladder-wall directly below the stalk of the tumor, but here, too, careful search failed to show the slightest evidence of epithelial infiltration in the submucosa or muscularis in any of them. Serial sections were not made.

Case XXXVIII.—This specimen was a coarsely papillary growth, about 2 x 3 cm., with a short stalk springing from the submucosa of the bladder-wall, containing large-sized blood-vessels. There was an intense inflammatory condition of both tumor and bladder-wall, evidenced by infiltration with leucocytes and necrosis. This considerably obscured the histology of the growth. The surface epithelium was mostly denuded; in one place only there were strips of a many-layered epithelium upon a connective-tissue stalk, forming a typical papillary process. The pedicle of the tumor, even close to its base, enclosed large masses of large variable-sized cells, some with several nuclei, which were regarded as atypical epithelial cells. There was no epithelial invasion of the bladder-wall itself.

Case XXXIX. — The specimen was that of a villous tumor, 2x3 cm., the smaller of 2 similar growths, arising by a number of separate fine stalks from the submucosa of the bladder-wall. Viewed with a hand lens, the growth resembled a jungle of long grass. The long slender stalks, which showed but little branching, were covered with a comparatively narrow layer of cylindrical or spindle-shaped epithelial cells. Towards their ends the stalks were bare, the epithelium being stripped off and lying around loose, mostly at the bases of the stalks. Mitoses were rare. Many plasma cells were found in the connective-tissue stalks. There was no epithelial infiltration of the bladder-wall.

Case XLI. — This specimen showed a delicate villous growth of small size 1½ x 1½ cm., arising from the submucosa of the bladder-wall by a bunch of separate connective-tissue stalks. These stalks were long and slender, with but few branches, and were mostly stripped of epithelium, the epithelial cells lying loose in confused masses between the bases of the villi. These cells were cylindrical and spindle-shaped and varied considerably. There was absolutely no epithelial infiltration of the bladder-wall. (Fig. 3.)

Summary. — A recapitulation of this analysis of the 11 cases regarded as papillomata may be stated as follows:

Four were demonstrated by complete histological examination of the base and bladder-wall to be benign. Cases XXX, XXXVIII, XXXIX and XLI.

Three may be considered benign as far as a histological examination of a portion of the bladder-wall goes. Cases XXIX, XXXIII, XXXVII.

Of the 4 remaining cases which were histologically doubtful, one case (No. XXI) may be reasonably considered to have been benign in the light of the subsequent clinical history; probably also Case XX. One case (No. XXVI) which recurred in a malignant form may have been such from the start, though not necessarily. One case (No. XXXV) is still doubtful.

Number, Size, Situation and Form.—In 7 of the 11 cases of papilloma the tumors were single; in each of the other 4 cases there were 2 tumors. There were no cases in this series with large numbers of papillomata—papillomatosis.*

The situation was not always exactly stated. The favorite site seemed to be at the base of the bladder near the ureteral openings. Where 2 tumors existed, the larger one was usually at the base of the bladder and the smaller on the posterior wall, at a point which would be in contact with the other when the viscus was empty. This was quite striking in Cases XXX and XXXVII, and seems to corroborate the theory of propagation by contact, which Albarran states is an indisputable fact.

In size the papillomata varied from one which was described in situ as being somewhat smaller than a lemon, which was the largest, to one the size of a small pea, the smallest.

As to form, there were two excellent specimens of the villous papillomata in Cases XXXIX and XLI; 6 were of the commoner, lobulated, or cauliflower type (Nos. XX, XXI, XXVI, XXXV and XXXVII). The 3 remaining cases represented intermediate forms.

Cases of Carcinoma.—The specimens in the 6 cases regarded as carcinoma, while affording sufficient histological data for a diagnosis, were not sufficient either in number or completeness to allow of a differentiation of varieties.

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* In case No. XXXV, recurrence in the form of papillomatosis has occurred since the first publication of this article.

One specimen was obtained at autopsy, the other 5 at operations. The latter were removed piecemeal, so that they were necessarily fragmentary and incomplete. Only one of them showed the muscularis of the bladder-wall. In the other 4 specimens the question of infiltration, as far as the microscope was concerned, remained undetermined. It has been stated that infiltration of the bladder-wall is the distinctive mark of a papillary carcinoma of the bladder, and such it is in differentiating it from a papilloma; but where the structure is not of a papillary nature the diagnosis can be adequately made from the type and arrangement of the epithelium and its relation to the connective tissue, without reference to the bladder-wall.

A brief description of these specimens follows:

Case XXIV.[1] — A sessile, friable tumor with a base the diameter of a silver dollar was removed by morcellement from the floor of the bladder. Sections of the fragments showed on the surface a few connective-tissue processes covered with epithelium, which were suggestive of a papillary structure, and a loose, columnar arrangement of epithelial cells in the connective tissue of what was regarded as the submucosa.

Case XXVII. — The projecting portions of a hard mass, involving the base and posterior wall of the bladder, were removed by morcellement. The specimen on section showed masses of large atypical epithelial cells invading a stroma of connective tissue. No mucosa or muscularis of bladder-wall could be recognized.

Case XXXI. — A "papillomatous" tumor of large size was removed from the anterior wall and base of the bladder. A section of a fragment of the growth showed in places an arrangement of the epithelium and connective-tissue stroma suggesting villi which had become fused; in other places the arrangement was of an alveolar structure. The cells were very large and flat, of squamous type. No part of the bladder-wall could be recognized as such, in the section. There were many cell inclusions in this specimen.

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[1] This case has been reported by Dr. F. B. Harrington. Boston Medical and Surgical Journal, May 29, 1902.

Six months later a secondary operation showed the base of the bladder completely studded with hard nodules, with considerable induration of the bladder-wall. Section of one of these nodules which was curetted off, showed solid masses of epithelial cells of smaller size than in the preceding growth, separated by fine, fibrous trabeculæ.

Case XXXII. — A portion only of a mass involving the right side of the bladder was removed. On section it showed solid masses of large epithelial cells infiltrating between the bundles of muscular fibres of the bladder-wall.

Case XXXIV. — At operation the bladder was seen to be covered with "villous-looking nodules," which were easily separated from the bladder-wall. The latter was diffusely infiltrated and the urethral orifice was surrounded by a growth which was scraped off. Section of a fragment showed masses of small epithelial cells separated by a fine vascular connective-tissue stroma. No "villi" were to be seen, nor could any portion of the bladder-wall be identified.

Case XL. — In this case the tumor was found at autopsy. An abstract of the report follows: In the bladder an irregularly ovoid, fairly smooth tumor, about 2¼ cm. in greatest diameter, with short pedicle, situated near the beginning of prostatic urethra, was found. The mucous membrane of the neck of the bladder and trigonum was generally beset with numerous small, whitish nodules. The prostate was enlarged. Sections of the tumor showed groups and columns of atypical epithelial cells in places forming more or less perfect tubular structures, arranged in a dense, fibrous-tissue stroma. A section of the prostate showed increase in the interstitial connective tissue and dilation of the tubules with atrophy of their epithelium. A few columns and masses of carcinomatous cells were present in the lymph-spaces. There were metastases in the retroperitoneal lymph-nodes. The growth was regarded as an adenocarcinoma, primary in the bladder.

Summary. — These 6 cases of carcinoma may be summed up as follows:

In Case XL, an adeno-carcinoma, which is a rare form of primary cancer of the bladder, the possibility that the original focus of disease was in the prostate cannot be positively denied.

In Case XXXII, an alveolar carcinoma, infiltrating the bladder-wall, the diagnosis is unassailable.

In Case XXIV, there was fairly satisfactory evidence of infiltration of the submucosa of the bladder-wall.

In the other 3 cases, microscopic evidence of infiltration of the bladder-wall was lacking; there was, however, macroscopic evidence of it at the time of operation. In all of the specimens the histological structure of groups of atypical epithelial cells enclosed in a connective-tissue stroma was sufficiently convincing; 2 cases (Nos. XXIV and XXXI) showed slight evidences of villi in places, sufficient to suggest papillary carcinoma.

The after-histories of these cases gives further proof of their malignancy, if any were needed.

In Case XXIV death resulted 6 months after the operation, the disease having returned with great loss of blood.

In Cases XXVII, XXXI, XXXII and XXXIV, death from the disease resulted in from 2 weeks to 6 months after operation. In no case was there an autopsy.

Malignant Degeneration of a Benign Papilloma.— There has been much discussion upon this important subject, the weight of authority seeming to favor the possibility of such a change. Civiale first advanced the view that a benign papilloma of the bladder, called at that period fungus, might take on a cancerous change. This view is shared by Küster, Thompson, Orth, Von Antal, Ziegler, Albarran, Zuckerkandl and many others.

On the other hand, Rauschenbusch does not believe in this transition, and Lubarsch holds that it is not proven. Nitze, in his vast experience, has never observed a case in which a tumor of the bladder, removed at a second operation, showed a different structure from the original.

The subject being of much practical importance, it seems worth while to examine briefly the evidence.

In the first place, there is the analogy of authenticated cases of papilloma of the larynx becoming cancerous. This has been shown by Semon to be much rarer than was generally believed. He collected statistics of 10,774 cases of benign tumors of the larynx, in only 5 of which did he find the evidence of carcinomatous change incontrovertible. The scarcity of these cases is explained by Wendel on the ground that papilloma of the larynx, unlike papilloma of the bladder, occurs mostly at an age when there is but slight tendency to cancer.

Secondly, clinical evidence seems to support the theory, for how else are cases to be explained, of which a number have been reported by Fenwick and others, where there have been symptoms of painless hæmaturia for 20 years or more, and at operation papillary tumors have been removed, showing but limited epithelial infiltration of their bases? It does not seem reasonable to suppose that such cases could have been malignant from the start, when symptoms have been so mild and the progress of the lesion so slow.

Thirdly, there is a considerable accumulation of histological evidence by different observers. Orth states that he has observed a bladder in which near a large, unmistakably cancerous, papillary growth, smaller papillary tumors were present, in which nothing of a cancerous nature was to be found. A large number of similar observations are recorded in the literature.

Zuckerkandl recognizes two modes of cancerous transformation of a simple papilloma. In one he describes the process as beginning in the tumor itself. In this form the epithelial cells in places lose their regular form and arrangement; they become packed together in dense masses, numerous mitoses attest their rapid growth, and as a result of this epithelial proliferation, the line of demarcation between epithelium and stroma becomes less sharp, and in places groups of epithelial cells will be seen breaking into the connective-tissue spaces. In more advanced stages the papillary processes become fused and unrecognizable, only a sparse stroma with blood-vessels remaining of the original framework.

In the second form, the tumor itself remains anatomically benign in appearance, while deep in the underlying bladder-wall small metastatic masses of epithelial cells attest the malignancy of the growth. This form is illustrated by a reproduction of an actual specimen of a villous papilloma of extremely benign appearance, the exquisite malignancy of which is, however, shown by the presence of a small epithelial thrombus in the midst of the muscular coat of the bladder-wall. The first form of transformation is also illustrated by specimens.

Noteworthy cases similar to these have been reported by Colley, Schuchardt, Wendel and others.

There is only one case in this series which can properly be considered under this heading:

Case XXVI.—After 3½ years of intermittent hæmaturia a papillary tumor was removed from the bladder by operation. This growth has already been described among the papillomata. (Figs. 6 and 7.)

There was a recurrence of symptoms and a second operation one year and six months later, with death from the disease two months after the second operation. At this second operation the bladder was found to be filled with large soft masses of cauliflower appearance, which were extirpated with cutting forceps. The largest of these masses removed was 3 cm. in diameter. The only specimen preserved showed on section 4 papillary stalks arising from a connective-tissue base. No portion of the bladder-wall could be identified. The connective-tissue stalks were comparatively narrow, quite vascular, branched freely, and were covered with a very thick layer of epithelial cells. These cells varied considerably in size, and were packed together without definite arrangement, so that in places adjoining villi appeared fused together, producing an appearance not unlike alveolar cancer. In other places the papillary structure was quite regular. Mitoses were numerous. Everywhere the line of demarcation between epithelium and connective-tissue was indistinct. The two tissues shaded insensibly into each other. Within a large blood-vessel of one of the stalks there was a group of epithelial cells; this was interpreted as an illusion, the result of the direction of the section, and not a real epithelial thrombus. Lying in the blood about the specimen, both at the surface and at the edge of the connective-tissue base, there were small clumps of epithelial cells which were regarded as probably broken from the villi. There were, however, two clumps of epithelial cells which lay directly within the connective-tissue of the base, not upon it, or at its edge, which could not but be regarded as evidence of infiltration. This fact, together with the macroscopic evidence of

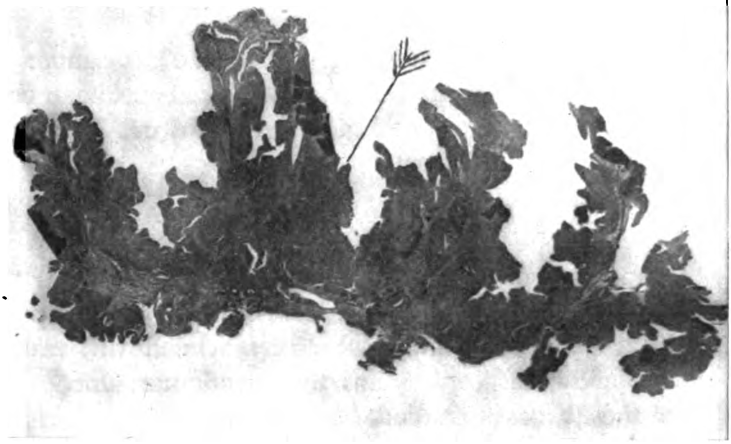

FIG. 8.— Section of a fragment of recurrent papillary growth removed at second operation in (Case XXVI) x 5 diameters. No bladder-wall is shown.

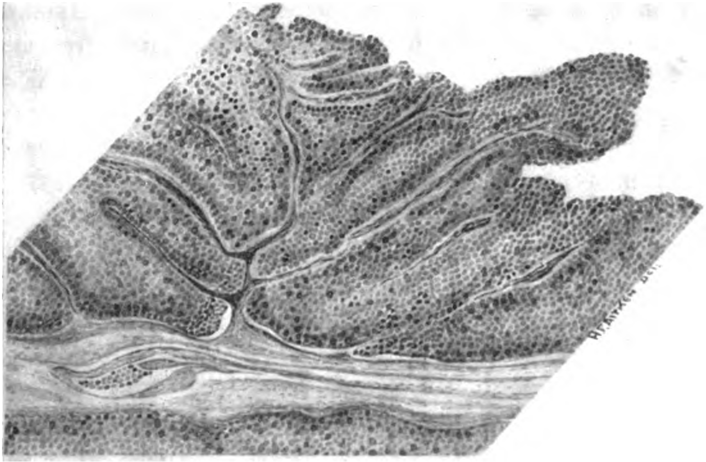

FIG. 9.— Low-power drawing of detail of same at point marked by arrow in Fig. 8. The relative increase in epithelium, and the atypical character and arrangement of the cells, also the fusion of the villous processes contrasts markedly with Fig. 7.

infiltration of the bladder-wall, makes it clear that the growth at the time of the second operation was a papillary carcinoma. (Figs. 8 and 9.)

This case is cited as a suggestive one; it cannot be claimed to be convincing, since the original specimen contained no bladder-wall, and therefore could not be proved to be benign.

SYMPTOMS AND COURSE OF THE DISEASE.

Hæmaturia is the cardinal symptom of tumor of the bladder; it is intermittent, at least at first, usually painless, except in malignant cases, unassociated with rest or motion, and unaffected by any therapeutic measure.

Of the 41 cases studied, hæmaturia was noted in 40, the only exception being Case XVIII, a myoma. In 20 cases it was the first symptom. In benign cases the bleeding may persist for years without other symptoms. The longest period noted among these cases was in No. V, in which case there had been intermittent hæmaturia for 16 years.

Sooner or later, however, a train of secondary symptoms is sure to arrive, due to infection of the urinary tract (cystitis, pyelitis, pyelo-nephritis, etc.,) or to mechanical blocking of the inflow or outflow of urine resulting in hydro or pyonephrosis or retention. The cases with symptoms of cystitis have already been enumerated. Retention was very common. Hydronephrosis was noted three times. Cases IV, XVII and XXXVIII.

Incrustation of the tumor with urinary salts is a frequent occurrence and has already been fully considered. Necrosis and ulceration are more common in malignant cases. Perforation into the intestines or peritoneal cavity may even occur. It was not noted in any of these cases.

In general the course of a malignant tumor is much the same as in a benign, only more rapid. Cancer of the bladder, however, is considered to be of comparatively slow growth, setting up metastases late. There is usually more pain than in benign cases and, after ulceration has set in, the condition of the patient becomes truly pitiable.

DIAGNOSIS.

The value of cystoscopy in making the diagnosis of this condition cannot be overestimated. Data as to the size, situation, character, and number of growths, also as to the advisability of operation, can be obtained by this means only.

The method is applicable to all cases with the 3 following exceptions: (1) where the urethra is impassable to the cystoscope; (2) where the hemorrhage is profuse and persistent; (3) where the growth on account of its size or position prevents the necessary manipulation of the instrument. The first obstacle can usually be overcome by appropriate methods of dilatation, the second by appropriate irrigation, or by the selection of a favorable opportunity, and the last is very unusual.

The method was employed in nearly all the recent cases in this series, and I think it might have been used with benefit in all of them. The time-honored methods of examination in all vesical diseases, such as examination of the urine, especially for villous fragments, rectal examination, etc., are also of value in making the diagnosis, and should not of course be neglected.

PROGNOSIS.

Albarran says, "En clinique, ce qu'il faut dire, c'est que toute tumeur vesicale est maligne ou peut le devenir."

Every tumor of the bladder unless removed will in time certainly lead to a fatal termination, either from hemorrhage, or as the result of the secondary changes already mentioned. Alleged cures by spontaneous extrusion of the growth through the urethra have been reported, but are too rare to substantially affect the truth of the preceding statement.

The clinical malignancy of the anatomically benign bladder-tumors could not be better illustrated than in Cases XXXIX and XLI.

Case XXXIX. — A laborer, 60 years of age, was brought to the accident department of the hospital, Dec. 22, 1900, with a history of having passed blood with his urine for 6 months. Three weeks ago the hæmaturia became constant. One week ago he took to his bed and has failed rapidly since.

He was profoundly anæmic, and nearly moribund when brought to the hospital. In spite of irrigations of the bladder with various styptics, the bleeding continued, and he died on the third day after entrance.

Autopsy revealed, as the source of hemorrhage, two pedunculated tumors, the larger 4 x 5½ x 1½ cm., about 2 cm. apart, springing from the mucosa of the bladder-wall just above the left ureteral orifice. One of these specimens was preserved and has already been described. There was no evidence either macroscopical or microscopical of epithelial infiltration of the bladder-wall.

Case XLI. — A man, 55 years old, entered the medical department of the hospital June 1, 1901, with the following history: An attack of hæmaturia 1½ years ago; at this time there was some pain referred to the penis. One year later there was another severe attack. For the last three weeks he has been passing blood and clots constantly. Has had heart trouble for years.

The bleeding continued, uninfluenced by various internal remedies and he died June 7. At autopsy, atheromatous endocarditis of the mitral valves was found, and fibrous endocarditis of the tricuspid valve with hypertrophy and dilatation of the heart. The bladder contained much clotted blood and showed on its posterior wall a small villous papilloma which has already been described. (See Fig. 3.) Other organs were not remarkable.

The severity of the cardiac lesions in this case undoubtedly explains why surgery was not resorted to.

TREATMENT.

The only effective treatment of tumors of the bladder is operative removal. In malignant cases palliative measures may be advisable.

The treatment was operative in 37 of the cases here reported. In no case was an attempt made to radically remove an infiltrating cancer of the bladder-wall. Palliative measures, such as curettage, cauterization, and partial removal, were resorted to for symptomatic reasons in such cases.

Pedunculated tumors were removed with or without portions of the underlying bladder-wall, as the case might be.

Suprapubic cystotomy was done primarily in 28 cases, perineal cystotomy in 4, vaginal cystotomy in one; in 4 female cases the tumors were reached by dilatation of the urethra.

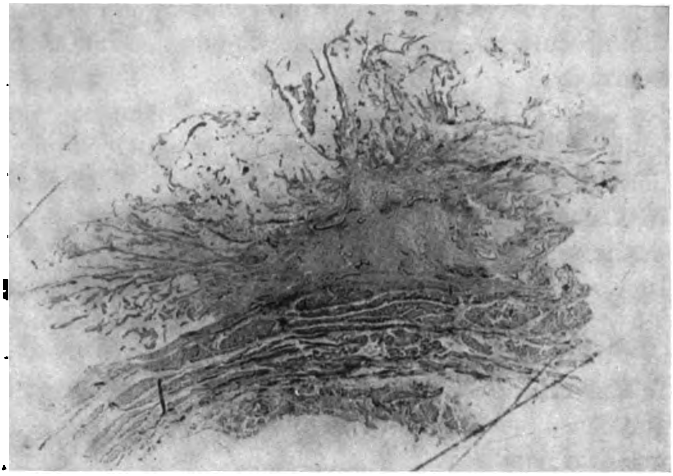

FIG. 3.—Section of a villous papilloma x 6 diameters, anatomically benign, clinically malignant (Case XLI).

In 4 cases secondary suprapubic operations were done for recurrences. In one case the first operation at the hospital was for recurrence.

Results of Operation.—Of the 37 cases of all kinds, benign and malignant, favorable and unfavorable, which came to operation, 9 resulted fatally within one month, or while still in the hospital, giving a mortality of slightly under 25 per cent. which can be ascribed to the operation.

Of the 28 patients who survived the operation and were discharged from the hospital, 26 have been traced; 14 (54 per cent.) of these are known to have died of the disease; 12 of them died within 18 months of the operation.

In the 2 cases which survived a longer time, secondary operations were done for recurrent growths. In one of these cases, life was prolonged for 5 years after the first operation; 3 suprapubic cystotomies and several tappings of a hydronephrotic kidney having been done altogether. (Case XVII.)

Four patients (15 per cent.) have died of other diseases, without recurrence of the bladder-tumors, so far as could be learned.

In Case I, the cause of death was given as "renal calculi," 13 years after the removal of a bladder-tumor, of which there was no microscopical report.

In Case V, cause of death was typhoid fever 9 years after the removal of a papillary epithelial growth.

In Case IX, pulmonary tuberculosis was the cause of death 3 years after the removal of a bladder-tumor, of which there was no microscopical report.

In Case XX "shock" (cerebral hemorrhage) was given as the cause of death, 1 year and 6 months after the removal of a papilloma.

Seven patients (27 per cent.) were living and well at the time this investigation was made; 2 of these (Nos. XXXVI, a case of fibro-myo-sarcoma, and XXXVII, a case of papilloma) are too recent to count. One patient (No. XIV), a case in which there was no microscopical report of the tumor, was well for ten years after the operation.

Four patients (Cases XXI, XXIX, XXXIII and XXXV, in which the tumors were papillomata), are living and well, respectively, 8 years, 2 years, 1 year and ½ year after the operation.

One patient (No. XVIII), a case of myoma, was in good health 2 years after the operation, but has not been heard from during the last 8 years.

It is impossible to fix upon any definite post-operative period of immunity as establishing a cure. Therefore, the word will be avoided in summing up the favorable results, which may be stated as follows:

Twelve patients (46 per cent.), including those who died of other diseases, have had no recurrence so far as known; 9 of these are known to have survived the operation 1 year; 7 survived the operation two years; 5 survived the operation 8 years; 3 of these dying of other diseases, leaving 2 patients (Nos. XIV and XXI), still living and well, respectively 8 and 10 years after operation.

The end results of the cases in which the histological character of the growths was personally studied, have already been incidentally mentioned.

The 5 cases of carcinoma which were operated upon, all resulted fatally within 6 months of the operation. In none of these cases was the operation radical.

Of the 8 cases of papillomata which were operated upon, there was:

One (Case XXX) in which death was the direct result of the operation.

One (Case XX) in which death resulted 18 months after the operation from another disease without recurrence.

One (Case XXVI) in which recurrence in the form of carcinoma took place, with death 2 months after a second operation.

In the other 5 cases (XXI, XXIX, XXXIII, XXXV and XXXVII) the patients are still living and well.

Recurrence.—The cases in which recurrence occurred have already been detailed. It is the rule in cases of carcinoma and sarcoma, and common in papilloma. It is doubtful if the word can be properly applied in all cases of subsequent growths of the latter type. There are numerous instances where papillomata reappear in the bladder after removal, not at their previous sites, but in other parts of the bladder-wall. In such cases there seems to be a predisposition or tendency towards the formation of papillary growths, which naturally is not affected by the mere removal of any one growth.

As a rule, rapidly and repeatedly-recurring tumors are malignant in the end if not from the beginning. *Vide* Case XVII of Table. That every recurrent papillary growth is malignant is not true, as is shown by the following case:

Case XXI. — A man, aged 55 years, entered the hospital July 16, 1897, with the history that 7 years before he began to have more or less trouble in passing urine, with frequency at night. There was a gradual onset of hæmaturia. Two years later he was operated on by Dr. Cabot in private, and a tumor was removed from the bladder by suprapubic cystotomy. He got along very well for three years after this, during which time it had been his custom to pass a catheter upon himself every other day. Then symptoms as before operation gradually returned. A suprapubic cystotomy was done by Dr. Cabot at the hospital. Two small pedunculated growths about the circumference of dimes were removed, and their bases cauterized. One of these was situated near the right ureteral orifice, the other to the right and behind the urethral orifice. The record stated that the latter was about on the site of the previous tumor.

The patient made an uneventful recovery and was seen by me on May 16, 1905, nearly 8 years after the second operation, when he reported his health to be excellent, without urinary symptoms of any kind. The urine was examined at this time and found to be normal in every way.

The two specimens in this case were alike. One of them has already been described. (See Figs. 4 and 5.)

CONCLUSIONS.

From this clinical and histological study of tumors of the bladder the following conclusions may be drawn:

1. Stone in the bladder is not an etiological factor of importance in the causation of these tumors.

2. The condition of the underlying bladder-wall in regard to epithelial infiltration, is the most satisfactory and reliable guide in the determination of the benign or malignant character of papillary epithelial tumors of the bladder.

3. If the foregoing condition is accepted as the differential test of these growths then will the benign forms commonly called papillomata, be found to at least equal if

not out-number the malignant, the papillary carcinomata.

4. Recurrent epithelial tumors are not necessarily malignant.

5. Papillary tumors of the bladder, proved to be histologically benign, may rapidly lead to a fatal result if let alone.

6. Surgical intervention at the proper time in the case of pedunculated papillary tumors of the bladder offers a very fair chance of long immunity, if not of permanent cure.

7. The method of surgical intervention to be preferred in these cases, is excision of the tumor in toto, with a margin of bladder-wall at its base, including mucosa, submucosa, and muscularis in part; the section need not penetrate the entire thickness of the wall. In this way, a beginning epithelial infiltration of the base if present, may be circumvented; or if it is not present, the knowledge of the fact is of great value in the important matters of diagnosis and prognosis. The defect in the bladder-wall should be closed with sutures, which will at the same time control hemorrhage. The gravity of the operation is not appreciably increased by this procedure.

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TABLE OF OPERATED CASES.

Case and Reference.	Date.	Age.	Sex.	Clinical Notes.	Operation.	Operator.	Nature of Tumor.	Immediate Result.	Ultimate Result.
I S.T.E.	Aug. 4, 1877	45	F.	Frequent and painful micturition for 2 years. Hæmaturia 2 months. Two previous plastic operations on vagina.	Dilatation of urethra. Digital removal of bladder tumor.	Dr. J. C. Warren.	Villous growth incrusted with urinary salts. No microscopical report.	Operative recovery.	Died 15 years later of renal calculi (Mass. Archives).
II M.R.	Nov. 1, 1883	53	M.	Hæmaturia 5 months. Severe pain, pyuria, chills. Passed cauliflower-like pieces of tissue.	Perineal cystotomy, villous growth removed with curette.	Dr. C. B. Porter.	Fragments of growth passed in urine examined and reported as villous cancer. No microscopical report of tumor itself.	Operative recovery. Discharged with perineal fistula.	Died 3 months later of cancer of bladder.
III W.S.P.	Jan. 8, 1885	42	M.	Painful and frequent micturition. Little blood at the end of urination for 4 weeks.	Perineal cystotomy, fungus growth removed with curette.	Dr. C. B. Porter.	Large rough tumor. No microscopical report.	Died 9 days after operation. *Autopsy*, cancer of bladder wall with sloughing. Interstitial nephritis	
IV F G.	Dec. 21, 1885	73	F.	First noticed urine was thick and brown 8 months ago; 2 months ago hæmaturia began accompanied by pain and frequency.	Vaginal cystotomy, tumor the size of two English walnuts attached to post. part of floor of bladder removed with curette.	Dr. A. T. Cabot.	Epithelial tumor incrusted with urinary salts (W. F. W.).	Died 7 days after operation. *Autopsy*, gangrenous cystitis, hydronephrosis and pyelitis.	
V L.J.D.	Sept. 27, 1886	34	M.	Intermittent hæmaturia for 16 years. Blood has been constant for past few months, occasional pain, retention twice.	Suprapubic cystotomy, white cretaceous growth scraped from bladder with curette.	Dr. C. B. Porter.	Examinations of fragments passed in urine after sounding showed the growth to be of a papillary epithelial nature. No microscopical report of the tumor itself.	Operative recovery.	Died 9 years later of typhoid fever (Mass. Archives).
VI J.J.R.	Sept. 28, 1887	59	M.	Intermittent hæmaturia for 16 months. Pain in lower abdomen.	Suprapubic cystotomy, sessile tumor removed, base cauterized.	Dr. M. H. Richardson.	No microscopical report.	Died in 6 days. *Autopsy* showed diphtheritic cystitis and cellulitis.	
VII J.C.	April 19, 1889	52	M.	No venereal history. Symptoms of cystitis for 9 months, blood in urinary sediment.	Suprapubic cystotomy, bladder tumor curetted out.	Dr. J. Homans.	Friable new growth largely filling bladder. Microscopical report, *Epithelioma* (W. F. W.).	Died in 7 days. No autopsy.	

TABLE OF OPERATED CASES. — *Continued.*

Case and Reference.	Date.	Age.	Sex.	Clinical Notes.	Operation.	Operator.	Nature of Tumor.	Immediate Result.	Ultimate Result.
VIII A.W.	Nov. 19, 1889	50	M.	No venereal history. Dull pain in loin, intermittent hæmaturia beginning 10 months ago following a fall, occasional retention from clots. Hæmaturia constant for 4 weeks.	Suprapubic cystotomy, small tumor near rt. ureteral orifice curetted out.	Dr. C. B. Porter.	No microscopical report.	Operative recovery.	Died of carcinoma of bladder 1 year and 5 months after operation.
IX M.M.	Jan. 9, 1890	29	F.	Symptoms of cystitis following confinement 9 months previous. Hæmaturia for 8 months.	Dilatation of urethra, tumor size of walnut at base of bladder curetted out.	Dr. J. W. Elliot.	No microscopical report.	Operative recovery.	Died 13 years later of tuberculosis of lungs (Mass. Archives).
X A.E.S.	Jan. 14, 1892	51	F.	For 2 years has had urethral discharge, at times blood stained; 5 weeks ago portion of growth removed from urethra. Symptoms, frequency, pain and tenesmus.	Growth involving urethra and ant. wall of vagina curetted, urethra dilated and papillomatous tumor of bladder curetted out.	Dr. C. B. Porter.	Microscopical report, *Infiltrating cancer* (W. F W.).	Operative recovery.	Died 8 months later of cancer of bladder.
XI S.C.W.	Jan. 18, 1892	55	M.	No venereal; 20 years ago had slight trouble in passing water for a few months, no further trouble until 1 year ago when he first noticed clots of blood in urine. Intermittent hæmaturia since. Retention from clots.	Perineal cystotomy, large papillomatous tumor attached to base of bladder removed with stone forceps.	Dr. A. T. Cabot.	No microscopical report.	Operative recovery. Developed insanity during convalescence.	Died 1 year later with recurrence.
XII E.S.	May 13, 1892	65	M.	Hæmaturia for 5 months. Pain and frequency followed. Lost 50 pounds in weight.	Perineal cystotomy, tumor size of walnut curetted off bladder wall.	Dr. J. Homans.	No microscopical report.	Operative recovery.	Further history unknown.
XIII J.G.	July 12, 1892	54	M.	Gonorrhœa 35 years ago. Symptoms of cystitis began 8 weeks ago, 6 weeks ago began to pass blood.	Suprapubic cystotomy, tumor removed with curette, tumor was size of baby's hand above the ureteral orifice.	Dr. A. T. Cabot.	Microscopical report, *Cancer* (W. F. W.).	Operative recovery.	Died 3 months later with recurrence.
XIV J.H.	July 10, 1894	34	M.	Gonorrhœa 15 years ago. Hæmaturia began 2 mos. ago following a fall. Constant bearing down pain.	Suprapubic cystotomy, hard and dense tumor 2 in. by 1⅛ in., on floor of bladder removed with chain écraseur.	Dr. S. J. Mixter.	No microscopical report.	Operative recovery.	In perfect health February, 1905. Personally examined.
XV J.E.B.	July 19, 1894	46	M.	In 1870 lateral perineal lithotomy. Frequency of micturition ever since. In 1889 suprapubic cystotomy by Dr. Cabot at M. G. H. "Pachydermia vesicae." Re-enters hospital with a broken-down suprapubic sinus and symptoms of severe cystitis with hæmaturia.	Suprapubic sinus dilated, bladder explored, portion of a new growth removed with forceps.	Dr. A. T. Cabot.	Microscopical report, *Epidermoid cancer* (W. F. W.).	Gradually failed, and died 1 month after operation. Autopsy showed cancer involving bladder wall, abdominal wall and retro-peritoneal glands.	

TABLE OF OPERATED CASES. — *Continued.*

Case and Reference.	Date.	Age.	Sex.	Clinical Notes.	Operation.	Operator.	Nature of Tumor.	Immediate Result.	Ultimate Result.
XVI G.C.F.	Dec. 22, 1894	61	M.	No venereal. Frequency for 7 months. Hæmaturia 8 weeks. Occasional stoppage. Pain for last 2 weeks.	Suprapubic cystotomy, growth curetted from int. urethral orifice.	Dr. C. B. Porter.	Fragments obtained by washing bladder reported as papilloma. Microscopical report of masses removed at operation. *Cancer* (W. F. W.).	Died 2 weeks later. No autopsy.	
XVII* S.H.T.	Jan. 9, 1895	53	M.	No venereal. Frequency of micturition with scalding began 6 years ago. Hæmaturia 1 year ago.	No. 1.—Suprapubic cystotomy, tumor size of Mandarin orange removed piecemeal from posterior wall.	Dr. S. J. Mixter.	No microscopical report.	Operative recovery.	**The hydronephrotic kidney refilled and was tapped several times subsequently. In March, 1901, sound could not be made to enter bladder, which seemed filled with new growth. Patient died of the disease a few months later.**
	Re-entry April 30, 1896			Relieved by operation for 1 year, then hæmaturia recurred.	No. 2.—Suprapubic cystotomy, tumor size of orange on ant. wall removed with scissors and base cauterized.	Dr. S. J. Mixter.	Microscopical report, cancer with slight infiltration of bladder wall (W. F. W.).	Operative recovery.	
	Re-entry June 23, 1897			Pain and hæmaturia recurred in 6 months.	No. 3.—Suprapubic cystotomy, papillomatous growth size of plum projecting from lower posterior wall of bladder removed with curette.		Microscopical report, Papillary cancer (W. F. W.).	Operative recovery.	
	Re-entry April 24, 1900			Pain and pressure in left side.	No. 4.—Cystic tumor in left hypochondrum tapped, ℥ cvii brownish fluid evacuated.	Dr. S. J. Mixter.		Temporary relief.	
XVIII M.V.B.M.	Nov. 12, 1895	57	M.	Stricture of urethra 15 years ago; 9 years ago renal colic, later passed some small stones, 1 year ago symptoms of cystitis began. In February, 1895, litholapaxy at M. G. H. and again in August by Dr. Cabot in private. In September a stone was washed out of bladder. In November same symptoms recurred and he re-entered hospital.	Suprapubic cystotomy, stone removed from post. prostatic pouch, two small hard projections incrusted with urinary salts removed from bladder wall.	Dr. A. T. Cabot.	Microscopical report, Myoma (W. F. W.).	Operative recovery.	**In good health 2 years after operation. Not heard from since.**

*** This case has been reported by Dr. Mixter. Boston Medical and Surgical Journal, April 20, 1899.**

TABLE OF OPERATED CASES. — *Continued.*

Case and Reference.	Date.	Age.	Sex.	Clinical Notes.	Operation.	Operator.	Nature of Tumor.	Immediate Result.	Ultimate Result.
XIX C.S.	Feb. 22, 1896	70	M.	No venereal. Pain and frequency 2 years, hæmaturia 8 months.	Suprapubic cystotomy, large sessile tumor on right side of bladder curetted out.	Dr. A. T. Cabot.	Microscopical report, Flatcell cancer (W. F. W.).	Died in hospital 4 months later. Incomplete autopsy showed bladder extensively involved in growth.	
XX S.B.	June 28, 1897	52	M.	Gonorrhœa, 30 years ago. Painless hæmaturia began 1½ years ago. Later pain in left testicle and kidney.	Suprapubic cystotomy, growth size of strawberry on posterior wall above trigonum removed, base curetted.	Dr. S. J. Mixter.	Microscopical report, Papilloma. Impossible to say whether malignant or not (J. H. W.).	Operative recovery.	Died 1 year and 6 months later of shock (cerebral hemorrhage) without recurrence of bladder symptoms.
XXI E.S.	July 16, 1897	55	M.	No venereal; 7 years ago symptoms of frequency and afterwards hæmaturia began; 5 years ago papilloma removed from bladder by Dr. A. T. Cabot in private; 2 years ago symptoms recurred as before.	Suprapubic cystotomy, two small tumors removed with forceps and their bases cauterized, one was situated to the outer side of the right ureteral orifice, the other behind urethral orifice about on the site of the previous tumor.	Dr. A. T. Cabot.	Microscopical report, *Papilloma*. Impossible to say whether or not malignant (J. H. W.).	Operative recovery.	Personally examined in May, 1905, nearly 8 years after second operation. Health perfect.
XXII H.A.T.	Sept. 26, 1899	63	M.	No venereal. Frequency and hæmaturia for 6 months. Occasional retention.	Suprapubic cystotomy, growth on right side of bladder extending toward prostate curetted out, base cauterized.	Dr. J. C. Warren.	Microscopical report, *Cancer* (W. F. W.).	Operative recovery.	Died 2 months later of recurrence.
XXIII N.K.	May 13, 1900	26	F.	Symptoms of cystitis with hæmaturia for 2 years following confinement. Passed several stones.	No. 1 — Dilation of urethra, two small tumors, one on posterior wall, one on left side, removed, bases curetted.	Dr. J. W. Elliot.	No microscopical report.	Operative recovery.	
	Re-entry Dec. 1, 1900			Painful and bloody urination, returned soon after leaving hospital.	No. 2 — Suprapubic cystotomy, deposit of calcareous matter on bladder wall curetted off, two small papillomatous masses removed.	Dr. R. B. Greenough.	No microscopical report.	Operative recovery.	Subsequent history unknown.
XXIV J.P.K.	Aug. 20, 1900	49	M.	Hæmaturia began 10 weeks ago. Pain and frequency began soon after.	Suprapubic cystotomy, sessile friable tumor with base size of silver dollar removed from base of bladder with prostatome.	Dr. F. B. Harrington.	Microscopical report, *Villous Carcinoma* (J. H. W.).	Operative recovery.	Died in another hospital with recurrence 1 year and 6 months later.
XXV L.V.	Oct. 29, 1900	69	M.	No venereal. Pain, frequency and hæmaturia began about 6 months ago.	Suprapubic cystotomy, a soft sloughing pedunculated tumor at neck of bladder removed with curette.	Dr. J. C. Warren.	No microscopical report.	Operative recovery.	Died 3 months later of cancer of bladder.

TABLE OF OPERATED CASES.— *Continued.*

Case and Reference.	Date.	Age.	Sex.	Clinical Notes.	Operation.	Operator.	Nature of Tumor.	Immediate Result.	Ultimate Result.
XXVI F.H.D.	Dec. 31, 1900	58	M.	Gonorrhœa, 38 years ago. Hæmaturia began 1 year and 3 months ago. Intermittent since. Frequency during last month; 3 attacks of retention.	Suprapubic cystotomy, soft papillary mass on left side of bladder removed with forceps, base cauterized.	Dr. A. T. Cabot.	Microscopical report, *Papillary cancer* (W. F. W.).	Operative recovery.	
	Re-entry July 2, 1902			Blood re-appeared in urine 6 months after operation and continued with frequency and tenesmus.	Suprapubic cystotomy, bladder filled with large soft cauliflower mass which was removed piecemeal with forceps.	Dr. A. T. Cabot.	Microscopical report, *Papilloma* (C. C. S.).	Discharged from hospital with permanent bladder drainage.	Died 2 months later of the disease.
XXVII F.L.	June 6, 1901	53	F.	Frequency 10 months. Hæmaturia 8 months. Pain.	Suprapubic cystotomy, hard irregular mass involving base and posterior wall of bladder, projecting portions of growth removed, curetted, and cauterized.	Dr. F. B. Harrington.	Microscopical report, *Mesothelial cancer* (W. F. W.).	Operative recovery.	Died 6 months later of the disease.
XXVIII S.S.	Mar. 11, 1903	58	M.	No venereal. Hæmaturia 10 months. Pain in left back. Frequency of micturition for 6 months.	Suprapubic cystotomy, a mass projecting into the right side of the bladder removed with prostatic forceps, the growth also extended into pelvis, no attempt was made to remove it.	Dr. A. T. Cabot.	Microscopical report, *Round cell sarcoma* (W. F. W.).	Discharged from hospital with permanent suprapubic drainage.	Died 2 months later of the disease.
XXIX T.A.B.	Mar. 17, 1903	59	M.	No venereal. Hæmaturia 3 months.	Suprapubic cystotomy, papillomatous growth to the left of prostate removed with a margin of normal mucous membrane with cautery.	Dr. A. T. Cabot.	Tumor size of end of finger incrusted with urinary salts. Microscopical report, malignant Papilloma. No evidence of infiltration of bladder wall (W. F. W.).	Operative recovery.	Letter of May, 1905, reports perfect health. No urinary symptoms of any kind.
XXX W.H.	July 8, 1903	57	M.	No venereal. Intermittent hæmaturia for 4 years. Slight pain and frequency.	Suprapubic cystotomy, papillomatous tumor size of egg removed from anterior wall on left, bladder wall sutured, third lobe of prostate found enlarged and removed with prostatome.	Dr. W. M. Conant.	Microscopical report, *Papilloma*, *probably malignant* (C. C. S.). Adenoma of prostate.	Died in 24 hours. *Autopsy* showed hemorrhage into bladder; on posterior wall of bladder small papilloma found; examination of bladder wall showed no epithelial infiltration	

TABLE OF OPERATED CASES. — *Continued.*

Case and Reference.	Date	Age.	Sex.	Clinical Notes.	Operation.	Operator.	Nature of Tumor.	Immediate Result	Ultimate Result.
XXXI N.W.	Jan. 31, 1904	40	M.	Operated on for stone in the bladder at the age of 9. No further urinary symptoms until hæmaturia began 2½ years ago. Intermittent since.	No. 1. — Suprapubic cystotomy, papillomatous tumor at base of ant. wall of bladder removed with prostatic forceps.	Dr. A. T. Cabot.	Microscopical report, *Epithelioma* (W. F. W.).	Operative recovery.	
	Re-entry Aug. 1, 1904			After leaving hospital improved at first, then old symptoms returned.	No. 2. — Suprapubic cystotomy, base of bladder studded with hard nodules, considerable induration of bladder wall, nodules removed with curette and cautery.	Dr. W. M. Conant.	Microscopical report, *Carcinoma* (C. C. S.).	Operative recovery.	Died of the disease 2 months later.
XXXII E.B.	Mar. 14, 1904	58	M.	No venereal; 1 year ago passed gravel, 6 weeks ago retention; 3 weeks ago pain and bleeding began.	Suprapubic cystotomy, mass involving left side of bladder, portion of growth removed.	Dr. M. H. Richardson.	Microscopical report, cancer.	Operative recovery	Died 3 months later of the disease.
XXXIII S.S.R.	May 10, 1904	63	F.	Intermittent painless hæmaturia for 2½ years.	Suprapubic cystotomy, pedunculated papillary growth size of lemon on posterior wall of bladder excised at base, defect in bladder wall sutured.	Dr. J. W. Elliot.	Growth, 6 cm. diam., pedicle, 1 cm. Microscopical report, *Malignant papilloma*. No evidence of infiltration of bladder wall. (W. F. W.).	Operative recovery.	Letter of May, 1905, reports perfect health. No urinary symptoms.
XXXIV E.B.	June 2, 1904	57	M.	Frequency 8 months. Pain in back and hæmaturia 1 month. Retention.	Suprapubic cystotomy, bladder mm. covered with villous nodules, urethral orifice surrounded by a growth which was scraped off.	Dr. S. J. Mixter.	Nodular fragments from the bladder, the wall of which was diffusely infiltrated with a new growth. Microscopical examination, *Cancer* (W. F. W.).	Died in 2 weeks; septic absorption. No autopsy.	
XXXV A.M.	Dec. 20, 1904	58	M.	No venereal. Hæmaturia began 2 years ago with constant dull pain in flank. Frequency occurred later.	Suprapubic cystotomy, pedunculated tumor size of strawberry just above right ureteral orifice removed with scissors, with small margin of mucous membrane, site of tumor cauterized.	Dr. L. Davis.	Coarsely papillary tumor size of horse-chestnut. Microscopical examination, *Malignant papilloma* (W. F. W.).	Operative recovery.	Suprapubic prostatectomy, Feb. 17, 1906. Recurrence 4 months later.
XXXVI M.S.	April 27, 1905	16	M.	19 months ago hæmaturia began accompanied by great pain. Frequency of micturition later developed with nocturnal incontinence.	Suprapubic cystotomy, a firm tumor size of orange arising by a thick short pedicle from the right side of internal meatus removed en morcellement, leaving a thick, ragged base which was cauterized, lower portion of tumor was incrusted with urinary salts.	Dr. F. G. Balch.	Microscopical report, *Fibro-myo-sarcoma* (W. F. W.).	Operative recovery. Discharged July 2 with small suprapubic fistula.	Case too recent for data.
XXXVII M.J.C.	Sept. 16, 1905	51	M.	Gonorrhœa many years ago; 2 years ago began to pass bloody urine without pain; 2 weeks ago retention.	Suprapubic cystotomy, larger tumor removed from right edge of trigonum with scissors, site of tumor cauterized, smaller one on posterior wall of bladder removed with a good margin, defect in bladder wall sutured.	Dr. J. G. Mumford.	Microscopical report, *Malignant papilloma* (W. F. W.).	Operative recovery. Discharged from hospital Nov. 4, 1905, with granulating wound above pubes.	Case too recent for data.

TABLE OF UNOPERATED CASES OF TUMOR OF THE BLADDER FOUND AT AUTOPSY.

No.	Date.	Age.	Sex.	Clinical Notes.	Post-mortem Findings.
XXXVIII Autopsy 87	April 15, 1897	70	Male	No venereal. Two years ago passed gravel. Five months ago began to have frequency of micturition. Hæmaturia began one month later and has been constant since, with much pain. Operation was deemed inadvisable on account of poor general condition. Patient slowly failed and died April 23, 1897.	"Papilloma of bladder. Diphtheritic cystitis. Inflammatory infiltration of peri-vesical tissues. Sl. pyelo-nephrosis of left kidney. Sl. hydronephrosis of right kidney. Acute peritonitis. Acute degeneration of kidney. Infarction of kidney. Arterio-sclerosis with cardiac hypertrophy and dilatation. Emphysema. Hypostatic congestion and œdema of lungs."
XXXIX Autopsy 641	Dec. 22, 1900	60	Male	Brought to accident room in extremely weak and anæmic condition with history of having passed bloody urine for 6 months. Failed rapidly during last 3 weeks. In spite of washing the bladder with various styptic solutions, the hemorrhage continued and the patient died in 3 days.	"Papillomata of the bladder. Hemorrhage into bladder. General anæmia. Fatty degeneration of heart muscle. Concentric hypertrophy and dilatation of heart. Arterio-sclerosis of aorta and coronary arteries. Chronic atheromatous endocarditis of mitral valve with acute vegetations. Œdema of lungs. Cholelithiasis. Hyperplasia of spleen. Cysts of right kidney. Right hydrocele."
XL Autopsy 681	Feb. 25, 1901	64	Male	No venereal. Severe attacks of pain in region of left kidney for 20 years. Hæmaturia during last 2 months. An exploratory nephrotomy was done with negative result, and the bladder searched for stone without result. Patient died 4 days later with partial suppression of urine.	"Nephrotomy with hemorrhage into peri-nephric and retroperitoneal tissues. Adenocarcinoma of the neck of the bladder with metastasis in the retroperitoneal lymphatic glands. Senile degeneration of the kidneys. Adenoma of the prostate. Chronic interstitial prostatitis. Chronic pericholecystitis and perihepatitis. Œdema of lungs. Ecchymoses in the mucous membrane of the stomach. Defective closure of the foramen ovale of heart."
XLI Autopsy 710	June 8, 1901	55	Male	Heart trouble since childhood. Painless hæmaturia began 1½ years ago. For 3 weeks the bleeding was constant. Bleeding continued while in the hospital, with death at the end of a week. (Operation not undertaken presumably on account of heart.)	"Papilloma of bladder with hemorrhage. General anæmia. Atheromatous endocarditis of the mitral and aortic valves. Fibrous endocarditis of the tricuspid valve. Hypertrophy and dilatation of the heart. Concretions in the prostate."

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